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VOL. CLIII.—No. 3967] LONDON: FRIDAY EVENING, JANUARY 22, 1932 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

VENTILATION.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 16th February, 1932, for the SUPPLY, DELIVERY, ERECTION, and PUTTING into SERVICE of TWO AIR CONDITIONING and VENTILATING PLANTS at the Commons and Senate Chambers, Northern Ireland Parliament Buildings, Stormont, Belfast.

Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8056

Technical Assistants.

TWO MECHANICAL ENGINEERS (unpensionable). Degree in Engineering or its equivalent and suitable workshop training essential. Salary £175 to £275 per annum, according to qualifications, plus Civil Service bonus (present total about £240 to £359). Must be British subjects. Age not exceeding 27 years. Preference and age concession to ex-Service men.

Application forms, returnable by 5th February, 1932, obtainable from CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Royal Arsenal, Woolwich, S.E. 18. 8031

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that ABRAHAM TEN BOSCH, of 205, van Lawick van Pabststraat, Arnhem, Holland, SEEKS LEAVE to AMEND the SPECIFICATION of the Application for Letters Patent No. 359,984, for an invention entitled "A Process for Reducing the Liquid Contents of Materials, which have Many Capillary Spaces."

Particulars of the proposed Amendment were set forth in No. 2243 of the Official Journal (Patents), published on January 13th, 1932.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
Comptroller-General.
8050

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.

Founded 1854 by SIR WILLIAM FAIRBAIRN.

Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

City of Hull Waterworks.

COTTINGHAM PUMPING STATION.
CONTRACT NO. C3.

The Water and Gas Committee are prepared to receive TENDERS from British Manufacturers for the CONSTRUCTION and ERECTION of TWO 30ft. by 9ft. LANCASHIRE BOILERS, BOILER MOUNTINGS, SUPERHEATERS, MECHANICAL STOKERS, COAL ELEVATORS, ECONOMISER and WATER SOFTENER at their Cottingham Pumping Station.

Copies of the specification and forms of Tender, together with drawings of the existing buildings, can be obtained on or after the 26th instant from the undersigned on payment of a deposit of £3, which will be refunded on receipt of a bona fide Tender.

Cheques to be made payable to the City Treasurer, Guildhall, Hull.

Sealed Tenders, endorsed "Tender for Boilers, &c., Cottingham," must be delivered at the Town Clerk's Office not later than 10 a.m. on Monday, the 15th February, 1932.

The Corporation reserve to themselves the right to accept the whole or any part of a Tender, and the lowest or any Tender will not necessarily be accepted.

W. D. BINGHAM,
Water and Gas Engineer.

Guildhall, Hull,
20th January, 1932. 8055

County Borough of Preston.

TENDERS are INVITED for the SUPPLY during the twelve months ending March 31st, 1933, of 4500 YARDS of 30in. Diameter STEEL WATER PIPES with Bituminous Lining and Exterior Sheathing.

Specification and form of Tender (returnable 11th February, 1932) may be obtained from the office of the Water Engineer, Tithebarn-street, Preston, and applications should be accompanied by a remittance of One Guinea, which will be returned upon receipt of a bona fide Tender for the work.

ALFRED HOWARTH,
Town Clerk.

Town Hall, Preston,
16th January, 1932. 8032

London County Council.

TENDERS are INVITED for the INSTALLATION of STEAM PLANT, STEAM and CONDENSE MAINS, GAS, WATER and FIRE HYDRANT MAINS, FORCED CIRCULATION HEATING and HOT WATER SUPPLY APPARATUS and MAINS and MISCELLANEOUS WORK at St. Nicholas Hospital, Plumstead, S.E. 18.

Specification, form of Tender, &c., in respect of the above work may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, on and after Wednesday, 13th January, 1932, upon payment of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if a bona fide Tender is submitted and is not subsequently withdrawn. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the CLERK OF THE COUNCIL at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 15th February, 1932, will be considered.

The Council does not bind itself to accept the lowest or any Tender. 8018

The Engineer

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PUBLIC NOTICES.

Corporation of Durban (Natal).

The Corporation of Durban (Natal) is prepared to receive TENDERS, from Manufacturers only, for the SUPPLY and DELIVERY to the Corporation's Stores, Durban, including all charges, and alternatively C.I.F. Durban, of :—

10,500 LINEAL YARDS TRAM RAILS, complete with TIE BARS, FISH-PLATES, BOLTS and BONDS, with SPECIAL CROSSINGS,

all to be approved by the Representative Engineers, Messrs. W. H. Radford and Son, Albion Chambers, King-street, Nottingham.

A deposit of £2 2s., returned on receipt of bona fide Tender, will be required.

Specifications can be obtained from the undersigned, and sealed and endorsed Tenders must be delivered to the Town Clerk, Municipal Offices, Durban, Natal, on or before Friday, 18th March, 1932.

The lowest or any Tender will not necessarily be accepted.

By Order,
WEBSTER, STEEL & CO.,
9, St. Helen's-place, Bishopsgate, London, E.C. 3,
Agents to the Durban Corporation. 8040

Newry Ship Canal Improvement SCHEME.

TENDERS FOR MECHANICAL EXCAVATOR.

The Joint Committee of the Newry Urban District Council and the Newry Port and Harbour Trust invite TENDERS for the SUPPLY, DELIVERY, and SETTING TO WORK on the Newry Canal of ONE MECHANICAL EXCAVATOR, Universal Type, ¾ cubic yard size, equipped with Dragline Scoop and mounted on Caterpillar Tracks.

The Excavator shall be fitted with a 40ft. long jib, equipped with a ¾ cubic yard scoop, driven by petrol or Diesel engine, designed to excavate under water in a depth of 15ft. of water, and shall be capable of removing stone pitching on the banks of the Canal. Information regarding the matters to be covered by firms tendering, and as to the working conditions may be obtained from Messrs. Ferguson and McIlveen, Consulting Engineers, 36, Scottish Provident Buildings, Belfast.

Tenders, accompanied by a complete specification of the machine, sealed and endorsed "Tender for Excavator," will be received by me up to Twelve o'clock Noon on the 28th day of January, 1932.

The lowest or any Tender may not necessarily be accepted. Firms tendering must be responsible for all expenses incurred incidental to the preparation and submission of their Tenders.

W. M. CRONIN (Town Clerk),
Hon. Sec. of Joint Committee.

Town Clerk's Office,
Town Hall, Newry,
January 14th, 1932. 8042

PUBLIC NOTICES.

County Borough of Swansea.

ELECTRICITY DEPARTMENT.

SUBAQUEOUS TUNNELS AND SHAFTS, DOCK INTAKE AND DISCHARGE AND FOUNDATIONS FOR POWER STATION AT TIR JOHN NORTH.

The Council invite APPLICATIONS for the TEMPORARY APPOINTMENT of CIVIL ENGINEERING INSPECTORS with experience of Heavy Reinforced Concrete Foundation Work and Construction of Tunnels and Cofferdams in connection with Dock Work.

Applications must be made on a form to be obtained from the undersigned, to whom applications shall be addressed, endorsed "Civil Engineering Inspectors," and be received not later than the first post on Monday, 1st February, 1932.

H. L. LANG-COATH,
Town Clerk.

Guildhall, Swansea,
21st Jan., 1932. 8061

South Indian Railway Company, LIMITED.

APPLICATIONS are INVITED for the APPOINTMENT of an ASSISTANT MACHINE SHOP FOREMAN in the Company's service in India.

Applicants should be between the ages of 35 and 45 years and should have received a sound mechanical training. They should have held the position of Foreman or Assistant Foreman in a large modern machine shop and have a good all-round experience in workshops in which up-to-date rate fixing, planning and progress systems are in force.

The salary of the appointment, which in the first instance will be for five years, will commence at Rupees 500 per mensem, rising by annual increments of Rupees 25 per mensem to Rupees 550 per mensem. The pay will, however, be subject to a temporary cut of 10 per cent.

A free passage to India will be provided by the Company, as also, subject to the terms of the agreement, a free passage home in the event of the termination of the service at or before the end of the five years. If the employment is extended beyond that period, the employee will become eligible for certain free passage concessions for himself and his family.

Salary will commence on the date of embarkation for India.

The successful candidate will be entitled to the benefits of the Railway Provident Fund.

Forms upon which application must be made may be obtained on written application to Messrs. Robert White and Partners, 3, Victoria-street, London, S.W. 1, the Consulting Engineers to the Company.

A. MUIRHEAD,
Managing Director.

Company's Offices,
91, Petty France, Westminster, S.W. 1. 8043

PUBLIC NOTICES.

County Borough of Swansea.

ELECTRICITY DEPARTMENT.

SUBAQUEOUS TUNNELS AND SHAFTS, DOCK INTAKE AND DISCHARGE AND FOUNDATIONS FOR POWER STATION AT TIR JOHN NORTH.

APPOINTMENT OF TWO ASSISTANT ENGINEERS.

The Council invite APPLICATIONS for the TEMPORARY APPOINTMENT of :

ONE ASSISTANT ENGINEER at a salary of £450 a year, and

ONE ASSISTANT ENGINEER at a salary of £350 a year.

The duration of the Works will be for a period of about 2 years, and the appointments will be determinable by one month's notice on either side.

It is essential that applicants shall have had previous experience of Heavy Reinforced Concrete Foundation Work and the Construction of Tunnels and Cofferdams in connection with Dock Work. Preference will be given to applicants who are Associate Members of the Institution of Civil Engineers, or who have passed the examinations for Sections A and B, or examinations exempting therefrom.

Applications must be made on a form to be obtained from the undersigned, to whom applications shall be addressed, endorsed "Assistant Engineer," and be received not later than the first post on Monday, 1st February, 1932.

H. L. LANG-COATH,
Town Clerk.

Guildhall, Swansea,
21st Jan., 1932. 8060

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

BOX P1855.—Situation has been filled. 8038

WANTED, the SERVICES of a GENERAL WORKS MANAGER, to Take Control of Slag Works and Quarries producing Roadstone Materials. Organising ability, engineering knowledge and experience of tarmacadam production essential. When applying please state experience and salary required. Good salary and prospects offered to the right man.—Address, P1956, The Engineer Office. P1956 A

WANTED, SALESMAN, Having Thorough Knowledge of all classes Boilers, large and small. Preference given to applicants having experience of de-scaling. Write full details, age, experience, salary desired, &c.—Address, P1949, The Engineer Office. P1949 A

PRODUCTION EXECUTIVE, Age 28-35, REQUIRED by well-known Engineering Company. University Degree or equivalent in Engineering preferred; four/five years' Workshop experience essential. Must have really first-class knowledge of Works Management and Modern Production Methods acquired while holding executive position.

Present salary should approximate £1000 per annum. Strict personal and business references required. Unique and permanent position for right man.

Address, in confidence, stating age, and giving detailed chronological statement of career, with salaries earned, 8059, The Engineer Office. 8059 A

WORKS MANAGER WANTED for Large Manufacturing Works. State age, qualifications, experience, and salary required.—Address, P1941, The Engineer Office. P1941 A

WANTED, MECHANICAL DRAUGHTSMAN, with experience in design of Printing and General Machinery. Capable men only need apply. State age, experience, and salary required.—Address, 8057, The Engineer Office. 8057 A

DRAUGHTSMAN, — Thoroughly Competent DRAUGHTSMAN WANTED for works about 25 miles south of London. Must have had considerable experience in designing of high-class machinery. State concise details of experience and salary required. —Address, 8046, The Engineer Office. 8046 A

SITUATIONS WANTED.

A.M.I. STRUCT. E., 38 Years, DESIRES POSITION in Structural Engineering Co., with control of drawing-office or designing and estimating dept.; 17½ years' London experience.—Address in confidence, P1937, The Engineer Office. P1937 B

B.SC. (Hons.), A.C.G.I., A.M.I.C.E. (32), 10 Years' experience field and office, tunnelling, sewerage, building, road and railway, French and fluent Spanish, SEEKS APPOINTMENT.—Address, P1953, The Engineer Office. P1953 B

CIVIL and MECHL. ENGINEER (38), University training, A.M. Inst. C.E., &c., 20 years' exp., works and D.O., structural steel, R.I.C. construction, plant and buildings, roads, drains, sea defence, bridges, &c., recently actg. res. engineer, P.W.D., REQUIRES POSITION, home or abroad.—Address, P1887, The Engineer Office. P1887 B

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The Engineer

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This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

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COMBUSTION ENGINEER, with Wide Experience in the Design, Installation, Operation and Manufacture of Mechanical Stokers (Chain Grates, &c.), is DESIROUS of CHANGE, preferably in connection with Steam Generation, as REPRESENTATIVE or similar post.
For full particulars address, P1960, The Engineer Office. P1960 B

ELECTRICAL ENGINEER (29), Unmarried, DESIRES progressive POSITION abroad. Sound technical and practical ability, seven years' versatile experience in the East of construction and maintenance large transmission and distribution systems, complete motor and switchgear installations for workshops and petroleum refining plants, overhead line construction in exacting conditions, intimate knowledge of economics, supervision of labour, &c.—Address, P1917, The Engineer Office. P1917 B

ENGINEER, A.M.I.M.E., M. Am. Soc. M.E., Experienced in mechanical and electrical estimates, construction, repairs and operation of chemical, mining, railways, Diesel and steam power plants, &c.; thorough knowledge of Spanish and the supervision of labour.—Address, P1938, The Engineer Office. P1938 B

ENGINEER (47) DESIRES ADMINISTRATIVE POSITION or one of trust. Just completed large reconstruction contract; cement works, collieries; works, drawing-office, management, consulting and administrative experience. — Address, P1948, The Engineer Office. P1948 B

ENGINEER (27), General or Struct., Exp. Shops, D.O., estimating and design, erection, supervision, smithing, foundry work, steam-raising plant and pipe work, sound tech. knowledge, 3 years charge of works, 1 year outside representative, DESIRES progressive POSITION, home or abroad.
Address, P1965, The Engineer Office. P1965 B

ENGINEER, M.I. Struct. E., DESIRES ENGAGEMENT; 20 years' experience, England and abroad; specialist in steel and reinforced concrete building structures, pile foundations, retaining walls, &c. Highest references.—Address, P1964, The Engineer Office. P1964 B

ENGINEER (32) SEEKS APPOINTMENT. Exp. works design, erection and maintenance steel and rubber industries.
BM/L024, London, W.C. 1. P1912 B

ENGINEER (28), Univ., Exp.: Steam Engines, O.I. engines, turbines, millwrighting; good results with powdered fuel on W.T. boilers; DESIRES PROG. CHANGE. Maintenance or Boiler Superintendent.—Address, P1961, The Engineer Office. P1961 B

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32 years old, specialist in most up-to-date strip cold mills and auxiliary machinery, also adaptation of obsolete plants, long and vast experience acquired with leading firms, WANTS POSITION as LEADING CONSTRUCTING ENGINEER. Knows English fairly well.
Write to K. O. 2570, c/o Rudolf Mosse, Cologne-o/R., Germany. 8030 B

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MECHANICAL ENGINEER DISENGAGED; 25 years' experience with leading machine tool manufacturers, jig and tool design and production methods; Midland or Southern District preferred.—Address, P1950, The Engineer Office. P1950 B

MECH. ENGINEER (24), 6 Years Pupil Loco. Eng., D.O. and works, subsequent exp. in steam engines, pumps, &c., excellent machine shop exp. Moderate salary.—Address, P1923, The Engineer Office. P1923 B

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REQUIRED, SITUATION Abroad; P.A.S.I. and M. and C.E., 15 years' experience, 8 years in East, buildings, roads, bridges, dredging, &c.—Address, P1943, The Engineer Office. P1943 B

STRUCTURAL DRAUGHTSMAN (22), A.M. Tech. I., 3 years' experience, good education, SEEKS SUITABLE POST; salary normal; would go anywhere.—Address, P1966, The Engineer Office. P1966 B

DRAUGHTSMAN (29 Years) of ASSISTANT ENGINEER, 4 yrs. shops (machine, fitting, erecting), 9 yrs. D.O. (general arrangements, details, estimating, calculations), thorough mechanical and structural experiences, first-class references, REQUIRES POSITION, home or abroad.—Address, P1951, The Engineer Office. P1951 B

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FOREMAN BOILERMAKER (PLATER) DESIRES ENGAGEMENT as Foreman or Inspector of Materials, Fabrication and Construction; experience of marine, water-tube and land boilers, steel-frame buildings and bridgework.—Address, P1959, The Engineer Office. P1959 B

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The Gebel Aulia Barrage.

AT the end of last week the Egyptian Cabinet approved the scheme for the construction of a new barrage on the White Nile at Gebel Aulia, about 30 miles south of Khartoum. The scheme, which has already been approved no less than three times since 1914, is estimated to supply Egypt with an additional 2,000,000,000 tons of water per annum, but it has on previous occasions been abandoned on account of political considerations on the ground that the construction of the new barrage would enable the Soudanese Government to control the supply of water to Egypt. The sum to be expended is to be distributed over the next four Budgets, but the scheme has yet to receive the sanction of the Egyptian Parliament. So far, we learn, no confirmation of the Cabinet's approval has been received by the consulting engineers in Westminster. The new barrage which is contemplated would form a sister reservoir to the Sennar, which supplies water from the Blue Nile to the Gezira irrigation scheme, and would constitute another important link in the vast scheme of irrigation for Egypt and the Sudan.

A Joint Meeting by Wireless.

AN interesting joint meeting between members of the Council of the British Standards Institution and spokesmen of the Standards Association of Australia took place over the long-distance trans-oceanic radio telephone circuit between London and Sydney on Thursday morning of last week at the offices of the Board of Trade. Although the transmission conditions were reported beforehand as being not of the best, clear transmission of all the speeches took place between about 12.30 and 12.45 p.m. Greenwich time. Colonel Sir Thomas Purves, the Chief Engineer of the General Post Office, presided over the meeting, and called upon the Right Hon. Walter Runciman, the President of the Board of Trade, to talk to Sir George Julius, the Chairman of the Standards Association of Australia. Mr. Runciman outlined briefly the history of the British Standards Institution. He said that it was primarily an industrial movement and claimed the fullest support from industry. He welcomed the working together of the British and Australian associations, and expressed the opinion that the development of standardisation in the various parts of the Empire, upon the basis of close co-operation in the establishment of uniform standard specifications, would make a definite and useful contribution to the growth of inter-Imperial trade. Sir George Julius, replying from Sydney, referred to the Australian Government's interest in standardisation and the value of Mr. Le Maistre's visit. Good wishes were then conveyed to the Australian Association by Mr. Maurice F. G. Wilson, and were acknowledged by Sir Henry Barraclough, Professor of Engineering at the University of Sydney. Mr. C. Le Maistre, the Director of the British Standards Institution, who is now on a visit to Australia, then spoke, and was followed by Sir William Larke, who expressed the desire of British industry to co-operate with Australia in developing her natural resources. After Mr. J. W. Lawson, of the engineering staff of the Australian Post Office, had spoken, Colonel Sir Thomas Purves wound up the conference with a tribute to the success of the transmission.

British Shipping and World Trade.

IN the course of a speech at the general meeting of the Houlder Line on Monday last, January 18th, Sir Frederick Lewis made reference to the gratifying increase in general trade, apart from chilled and frozen meat, of the firm's refrigerator ships. He further stressed the value of reciprocal trade arrangements with the Argentine, the Brazils and other South American and European countries. Sir Frederick characterised as false the theory that by reserving the Empire coasting trade for British ships the shipping position would be improved. While some nations reserved their coasting trade, partly or wholly, for their national ships, that was a state of affairs which he thought we should break down rather than extend. The foreign carrying trade of British shipping was much greater than the amount of British coasting trade which was conducted by foreign shipping. The latest statistics showed that of the shipping entered and cleared at United Kingdom ports, with cargoes, 65 per cent. was British. In open competition British shipping retained no less than 99 per cent. of United Kingdom coasting trade. If the trade of the United Kingdom with the British Dominions and the trade with foreign countries were to be taken separately, then 96 per cent. of the shipping entered and cleared at United Kingdom ports to and from British possessions was carried in British ships. Apart from these facts it was probably correct to say that trade between entirely foreign countries was carried by British ships to the extent of about 30 per cent. of the whole. Of vessels of over 2000 tons gross upwards, 40 per cent. was under the British flag, and carried between 40 and 50 per cent. of the world's sea-borne trade. As the overseas trade of the British Empire was certainly less than that percentage of the whole, it was obvious that British shipping carried more foreign traffic than *vice versâ*. The British shipping industry had always pleaded for freedom of action, freedom from restriction, freedom from artificial support—in fact, freedom to work out its own salvation. That policy, he was convinced, was still the sound one. When trade revived British shipping would be found trading in every part of the world and holding its own in any open field.

The "Grid" in South Scotland.

IN an address which Mr. A. E. McColl delivered a few days ago at a luncheon of the Glasgow Rotary Club, the preparations which are now being made in connection with the Central Electricity Board's South of Scotland Scheme were referred to. Owing to its capacity to market large quantities of electrical power, Mr. McColl explained, the "grid" system had given an impetus to the development of various water power schemes which would provide a still further contribution to the solution of the problem of unemployment. He referred particularly to the Grampian Power Company's hydro-electric developments at Rannoch and Loch Tummel, and to the larger development of the Galloway Water Power Company, in the South-West of Scotland. An impetus to the further development of Scotland's water power resources, he said, would be given when the industrial situation had recovered sufficiently to warrant the Board seriously considering an extension of the present "grid" system in Central Scotland to North England. Preparations were being made to construct high-pressure transmission lines which would run through South Scotland and connect Glasgow and the West of Scotland with Manchester and the industrial districts of Lancashire and North-West England. The work was part of an economically justifiable scheme for the sale of a large amount of hydro-electric power from Scotland to England, and the profits from the sale of that energy would enable the Board to construct and maintain subsidiary or lower pressure lines, which would serve rural districts in Scotland, to which, in the ordinary way, a supply could not be economically given. Work had been begun on the South Scotland Scheme, which, including the expenditure on the Galloway water power stations, would cost over £5,000,000.

Financing the French Line.

As recorded in a Journal note of January 1st, the revised Bill advocating further State support for the French Line was recently sent on by the Chamber to the Finance Committee of the French Senate for its further consideration and approval. On Tuesday, January 19th, the Senate Finance Committee rejected the Government's revised Bill, providing for a State loan of £2,400,000, with State nominees to the board of directors and State control. The Committee, while recognising that some form of State aid to the company is inevitable, has decided that until further guarantees of a strict reorganisation and of official control of the company's affairs are forthcoming, and until further inquiry into the responsibility for the company's present position has been made, it is not advisable to authorise other than provisional grants large enough to keep the undertaking in operation. This decision may, it is possible, have some effect on the rate of advance made with the construction of the company's new 73,000-ton liner at St. Nazaire, the machinery for which, it is now officially stated, is of the turbo-electric type, and is under construction at the Belfort factory of the French electrical firm "ALSTHOM." According to later news, it is understood that the money to be advanced will be sufficient to keep the work in progress, at least until a final decision with regard to the new liner is taken.

Efficient Distribution in Industry.

AT a meeting of the Commerce Society, which was held at the London School of Economics on Tuesday evening last, January 19th, Mr. J. Gibson Jarvie, chairman of the United Dominions Trust, in dealing with the present industrial outlook, strongly opposed any general reduction in wages, which, he held, would merely result in reducing consuming capacity and engendering strife and turmoil, with a diminishing production of real wealth. He also condemned the policy of manufacturers in reducing output in times of depression. What was needed, he said, was increased production, which was linked up with the whole question of distribution. The problem, in Mr. Jarvie's view, can only be solved by the extension of consumer credit, involving hire purchase or instalment selling. That system of credit, he recalled, had first been developed in connection with the motor car industry, but it had been extended to many other industries. Credit, however, for the purpose of consumption had, in any organised form so far, been practically non-existent. It was interesting to record that of the outstanding commitments of hire purchase and instalment buying in 1929, 95 per cent. had been liquidated within twelve months, while the loss ratio was negligible. Factories, continued Mr. Jarvie, might be re-equipped through the system, and people thereby could acquire productive merchandise. By such a means of distribution production would be increased and prices would come down. With regard to the Empire and Free Trade position, Mr. Jarvie held that free imports must cease, and that we must take the power to bargain with other countries. By negotiation and preferential arrangement we might yet command a senior position in those wealthy markets which were offered to us by our Crown Colonies and Dominions. Through Protection we might gain the widest system of real Free Trade over the biggest area of land which the modern world had yet known, and only by such means could we raise our production sufficiently to achieve competitive prices, so distributing our goods abroad, and again re-establishing a favourable trade balance.

Large Flying Boats.

ON grounds of economy, work has been stopped upon the construction of the Supermarine (Vickers) six-engined forty-passenger civil monoplane flying boat, the order for which was placed by the Air Ministry nearly two years ago. It is stated that the Ministry is now negotiating with the constructors with the object of securing the cancellation of the contract. This very large and interesting machine was briefly described and illustrated in our issue of January 2nd, 1931. Its completion would certainly have enabled this country to obtain valuable experience in the operation and employment of large flying boats, but the Ministry's decision to interrupt and possibly abandon its construction will not have as serious an effect on our aeronautical position as some, commenting upon the step, have suggested. The truth is that the Supermarine machine is still far from being complete, whereas an even larger flying boat, built to the order of the Air Ministry by Short Brothers at Rochester, is now finished and practically ready for trial. The abandonment of the Supermarine machine can therefore hardly be justly described, as one writer has it, as a blow to the development of a flying boat suitable for Atlantic services. The Short machine, as we noted in our issue of January 1st this year, will, under prescribed conditions, have a paying load of 23,000 lb., and will possess a high speed and a long range. A flying boat to act as a "depôt ship" to it is in hand. The stoppage of work on the Supermarine flying boat has led some writers to express the hope that it will now be possible for the Air Ministry to proceed with the construction of high-speed mail planes, for the production of which it called for tenders some time ago. These craft are intended to speed up our air mail services on such routes as that to the Cape. They are single-seaters, capable of carrying a heavy load at high speed, and are intended to operate with supercharged engines at high altitudes. Here, again, the commentators seem to have gone a little astray. Orders for several of these mail planes have already been placed; and at least three designs have actually been constructed. We illustrated two of them—the Saunders-Roe and the Spartan—in our issue of January 8th. A third—a single-engined design—has been produced and built by A. V. Roe and Co., Ltd., and an example of it has recently returned to this country after a successful demonstration tour in Canada and the United States.

The Late Mr. Brennan.

WE regret to have to record the death of Mr. Louis Brennan, at Montreux, in Switzerland, at the age of eighty. He was born in Ireland in 1852, and will always be remembered for the torpedo bearing his name and the Brennan gyroscopic mono-rail. It was while living in Melbourne, Australia, that he developed the torpedo, which he later sold to the British Government for over £100,000. The Government set up a Brennan Torpedo Factory, of which he became first Superintendent, and later consulting engineer. Between 1896 and 1912 he was busy experimenting with the gyroscopic mono-rail car, which was fully developed by the time the war broke out, and arrested further experimental work upon it. Mr. Brennan was an inveterate inventor. One of his most notable inventions was a helicopter, on which much experimental work was done. For some time the Air Ministry encouraged the work, but eventually the experiments were abandoned. We propose to give a memoir of Mr. Brennan in our next issue.

The Cape Air Mail.

ON Wednesday last, at 12.30 p.m., the first regular air mail to Cape Town and intermediate stations left Croydon for Paris. The machine carrying the mail, which comprised about 20,000 letters and 180 parcels, was the four-engined Handley Page air liner "Helena." The machine, which was piloted by Commander A. B. H. Youell, took off promptly. It arrived safely in Paris two and a-quarter hours later. From Paris the mails are taken to Brindisi by train and will then cross the Mediterranean by flying boat and subsequently traverse the South African airway route described in our Journal note of November 20th. The through passengers included Mr. F. G. L. Bertram, Deputy Director of Civil Aviation, and Air Vice-Marshal Sir Vyell Vyvyan, a director of Imperial Airways. A large party representing the Dominion of South Africa, the Colonial Governments, and the various Departments of State which have taken a share in preparing for the service, gathered at the Croydon airport to give the liner a good send-off.

Lay-out of Hump Shunting Yards.

PRACTICALLY all modern marshalling yards on railways are laid out for the shunting of wagons to be done by gravity, and that method is now incorporated in all schemes for reconstructed and enlarged yards.

The introduction of gravity as a means of movement at once furnishes many problems that are unknown in flat shunting, where the wagons are moved by engines or horses. The solution of many of these problems is, moreover, contingent upon the manner in which some other features of gravitational shunting are dealt with. So inter-related are all the factors that a weakness at any one point may spoil the efficiency of a yard, and give an inadequate return upon the capital expenditure.

The measure of success of a gravitational yard is the time that elapses between the arrival of a wagon in the yard and its being placed in position for dispatch. Certain features enter into the earlier stages, such as the length of the reception lines in which the trains, whose wagons have to be sorted, are placed on arrival; the power of the hump locomotive; and the gradient of the ascending side of the hump, up which the engine pushes the wagons.

The essentials that make for the success of a hump yard, beyond those mentioned above, are:—The height above yard level of the summit of the hump; the length and gradients of the descending side of the hump; the closeness of the switches of the various sidings that lead off from a common point; and the clearance point of each siding that has to be reached by a wagon as quickly as possible. The two latter are covered by the term "lay-out."

It should at this stage be remarked that as the success of retarders—sometimes called rail brakes—has been conclusively proved by experience, their provision is regarded as one of the essentials of a gravitational yard. Retarders are generally fixed between the foot of the descending side of the hump and the first set of switches in the lead tracks.

It must be remembered that all wagons are not in the same running condition. Some are "good runners," because of their better maintenance, lubrication, and heavier loading; some are "bad runners," owing to the need of repair, insufficient or inefficient lubrication, and light loading.

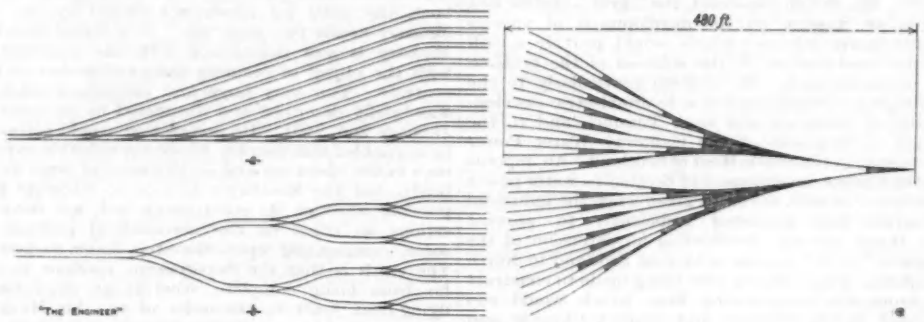
The problem which the designer of a hump yard has therefore to solve is—(I.) to determine the height, length, and gradients of the descending hump; (II.) the track lay-out and the disposition of the retarders.

Taking first the length and gradients of the descending side of the hump, it has to be observed that the two extreme conditions to be met are:—(*a*) Heavy, good running wagons under most favourable conditions, such as hot weather, following wind, &c.; and (*b*) light, bad-running wagons under the least favourable conditions, such as cold weather, adverse winds, &c.

The hump must be sufficiently high to overcome the worst conditions, and the retarders must be capable of preventing wagons, coming under the best conditions, from attaining excessive speed and either running out of the yard or colliding, with too great an impact, with other wagons that may be standing in the classification tracks.

The designer must also provide for the following further conditions:—(III.) To separate the wagons or "cuts" quickly on leaving the summit of the hump; (IV.) to divide up the cuts into as many streams as possible in the shortest time; (V.) to provide sufficient impetus to the worst running wagons to enable them to run well into the classification roads past the farthest clearance point, without letting thebet ter-running wagons attain an excessive speed at any time.

In order to design the hump to comply with these conditions, certain data must be available. Values, for instance, are required, in pounds per ton, of wagon resistances met with, curve and switch resistance, and the effects of prevailing winds, if any.



FIGS. 1 AND 2

In this country the maximum and minimum values of wagon resistance may be taken as 18 lb. and 5 lb. per ton respectively. Opinions vary as to the values to be taken for curve and switch compensation, but experience has shown that the average values are 0·1ft. drop for each switch and 0·045ft. drop for each degree central angle of curvature.

Beyond the foot of the hump comes the switch area, wherein are the retarders. The switch area, particularly that portion after the last set of retarders, should be made as short as possible, in order that wagons may take as little time as possible to run clear of the last switches after leaving the retarders, for the following reason:—

An unbraked, good runner, following behind an unbraked bad runner will tend to catch up the latter, up to the time when the former is retarded by the rail brakes, after which time the bad runner may gain time on the good runner. So that, if the last clearance point is some considerable distance away from the retarders, the retarded good runner may take such a time to clear the last switches that a following unbraked bad runner will catch it up while it is still in the switch zone.

A means of attaining this end is to adopt the "balloon" lay-out—*b*, Fig. 1. This type of lay-out also divides up the tracks into several groups and complies with condition (IV.) mentioned above, *i.e.*, it enables the cuts to be separated into several streams in the shortest possible distances. This division of the cuts into several streams enables all the classification tracks to be made approximately of the same length, and decreases the length of track that has to be kept clear of wagons. Comparison between the eight tracks arranged on the ladder system in *a*, Fig. 1, and the similar number of tracks arranged on the balloon system in *b*, Fig. 1, shows that, with a yard having thirty or forty tracks, the saving in length would be appreciable. The latter lay-out is a simple balloon example. With judicious use of overlapped switches the length can be very considerably reduced indeed, and Fig. 2 shows a lay-out of thirty-one tracks in which the distance from the first switch to the farthest clearance point is only 480ft.

A further advantage of the balloon lay-out is that the curve and switch resistance is approximately the same for each track. The most suitable number of tracks to be included in each group is found to be four.

In arranging the track lay-out space must be left for the retarders. The numbers of these will depend largely upon the amount of money that is to be spent on the yard. As we shall show hereafter, the capacity of the yard can be considerably increased by the inclusion of retarders on the lead tracks, but it must be remembered that the farther down the yard the retarders are placed the larger the number required.

The classification tracks are either constructed on the level or on a slight downward gradient. This gradient, if adopted, must be a non-accelerating one for the good running wagons, otherwise they will gain speed after leaving the last retarders and will not come to rest as required. In theory this compensation would be slightly different for each track, but as it is impracticable to lay each track on a different gradient a compromise has to be made.

An average value for such a gradient is 1 in 450, which is non-accelerating for wagons with a running resistance of 5 lb. per ton. To this gradient compensation for curvatures and switch resistance must be added.

Having decided upon the track lay-out and the gradients through the classification tracks, the speed at which a bad-running wagon will have to enter these tracks can be calculated.

In general, assuming the following quantities:—
Max. distance to be run after foot of hump, S_1 feet.
Max. wagon resistance, R lb. per ton.
Final effective gradient, 1 in x.

Drop over the S_1 feet $= \frac{S_1}{x}$ feet.

$\therefore$ energy acquired through gravitational effects

$$= \frac{S_1}{x} M \times 2240 \text{ foot-pounds,}$$

where M = weight of the wagon in tons. Energy removed by resistance $= M \times S_1 \times R$ foot-pounds.
Hence resulting braking effect by friction

$$= M S_1 \left(R - \frac{2240}{x} \right) \text{foot-pounds.}$$

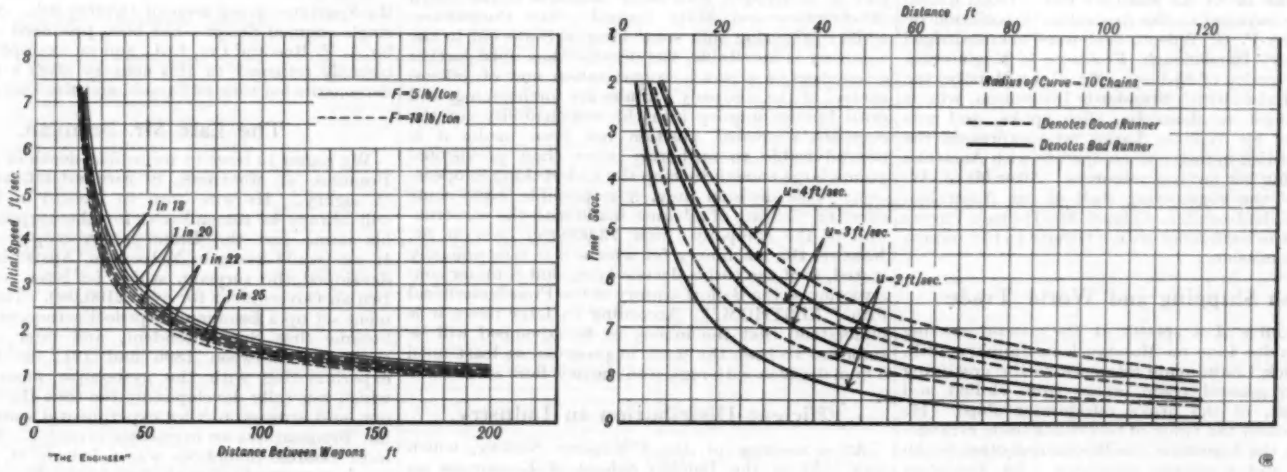
Therefore the maximum K.E. which a bad-running wagon may have at the foot of the hump is the energy represented by this expression.

Hence if v ft./sec. is the speed of the wagon at the foot of the hump.

$$\frac{2240\ M\ v^2}{2g} = M S_1 \left(\frac{R - 2240}{x} \right).$$

$$\therefore\ v = \sqrt{\frac{2g S_1}{2240} \left(R - \frac{2240}{x} \right)} \text{ ft./sec.} \quad . \quad . \quad (1)$$

From this expression we can get the theoretical or



FIGS. 3 AND 4

effective height of hump necessary. Let this be h feet. Then $\frac{M v^2}{2g} = M h$.

$$\therefore\ h = \frac{1}{2g} \times \frac{2g S_1}{2240} \left(R - \frac{2240}{x} \right) \text{ feet}$$

$$= S_1 \left(\frac{R}{2240} - \frac{1}{x} \right) \text{ feet} \quad . \quad . \quad . \quad (2)$$

In order to obtain the actual height account has to be taken of the frictional effect encountered during the run down the hump. If, now, we let the distance from the summit of the hump to the bottom be S_2 feet, we have the energy removed by friction

$$= R M S_2 \text{ foot-pounds.}$$

So that the extra height to be added to overcome this

$$= \frac{R M S_2}{M \times 2240}$$

$$= \frac{R S_2}{2240}.$$

The total height of the hump therefore becomes

$$S_1 \left(\frac{R}{2240} - \frac{1}{x} \right) + \frac{R S_2}{2240} \text{ feet} \quad . \quad . \quad . \quad . \quad (3)$$

As a numerical example, let us suppose we have under consideration a yard where the following values have been decided upon :—

Distance to run, S_1=1000ft., final gradient 1 in 450.

Max. resistance, 18 lb. per ton.

Then, we find, the height of hump necessary

$$=1000\left(\frac{18}{2240}-\frac{1}{450}\right)+\frac{18\,S_2}{2240}$$

$$=5\cdot8+0\cdot008\,S_2 \text{ feet.}$$

The value of S_2 will, of course, depend upon the hump gradients decided upon.

We must now return to the hump in order to decide the gradients of the descending portion. These have to be arranged, first, to separate the wagons quickly at the start; and, secondly, in conjunction with the retarders, to keep them at their correct intervals throughout their run.

The distance between two successive cuts must be such that there is time for the points to throw between them where necessary. In most modern yards the points are track locked, so that they cannot be thrown under the wheels of a wagon. For this purpose the track circuit for each set of points must be for such a length in the approach to the points that the fastest-running wagons would not be able to run on to the points whilst they were in mid-stroke.

The length of these track circuits is very important, because on them depend the spacing necessary between wagons and therefore the gradients used on the hump, and also the speed at which humping can be carried out. It must be remembered also that the time interval between two wagons or cuts must not be less than the time taken for the worst-running wagon to clear the track circuits. Hence the speed of humping is largely limited by the length of these track circuits.

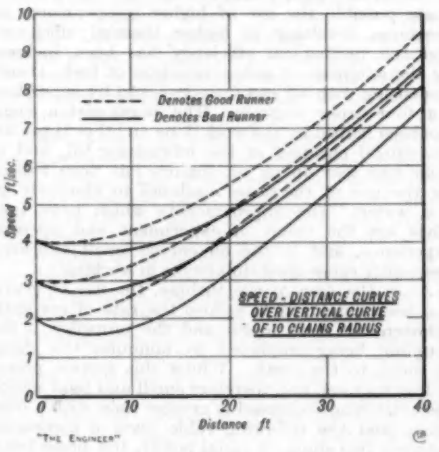


FIG. 7

If s is the length of the first track circuit, it is clear that the distance between two wagons travelling at the same speed, when the first one reaches the beginning of the track circuit, must be at least s feet. This, then, must be the distance run down the initial slope by the first wagon during the time that the second is actually passing over the crest of the hump. The actual distance run in this time will depend upon three factors :—

(*a*) Speed of humping.
(*b*) Initial gradient.
(*c*) The length of the second wagon, buffer to buffer.

(*a*) and (*c*), of course, combine to give the time taken by the second wagon to pass over the summit.

Let us again generalise and make the following assumptions :—

s feet=distance travelled by first wagon while second is passing over the summit.

u feet per second=humping speed.
l feet=length of wagon, buffer to buffer.
t sec.=time taken.

Then

$$s=u\,t+\tfrac{1}{2}f\cdot t^2.$$

$$u=\frac{l}{t}$$

$$\therefore\ s=l+\tfrac{1}{2}f\cdot t^2.$$

$$\therefore\ t=\sqrt{2\left(\frac{s-l}{f}\right)}.$$

$$\therefore\ u=\frac{l}{\sqrt{2\left(\frac{s-l}{f}\right)}}. \quad . \quad . \quad . \quad . \quad (4)$$

f being the effective acceleration down the initial gradient which can be easily calculated.

So, for a maximum humping speed, f must be as large and s as small as possible. In other words, the initial gradient must be as steep as is possible within reason and the length of track circuit must be the minimum permissible.

The curves in Fig. 3 show the relationship between the distance between two wagons by the time the second has entered the initial grade and speed of entering initial grade, for various gradients. For the purpose of calculating these curves, the length of wagon has been taken as 17·5ft. It is realised that this applies only to small wagons, but it is these that provide the limiting conditions and must therefore be considered. Longer wagons, and cuts of more than one wagon, will take longer to pass over the summit and the time interval between them and a preceding wagon will thus be greater, so that, if matters are arranged satisfactorily for the smaller wagons, the longer ones will offer no difficulties.

Normally, the switch turn-out will determine the length of track circuit necessary, and therefore the distance needed between wagons and, hence, the humping speed possible.

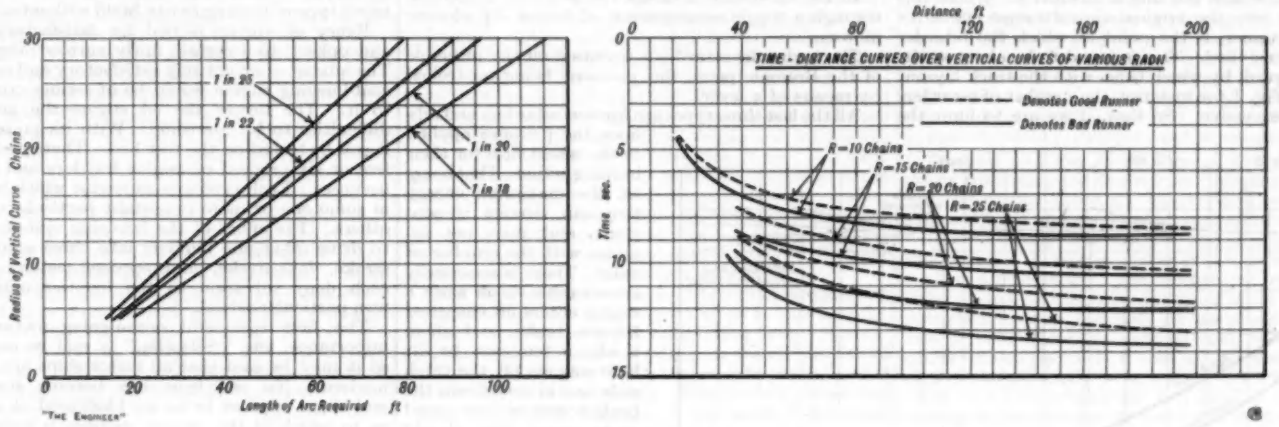
It will be seen from the curves that, whereas the variation in gradient from 1 in 18 to 1 in 25 makes only about 0·5ft. per second difference in initial speed for any given wagon spacing, for any given initial speed the wagon spacing is increased very considerably, especially at the lower speeds.

From these curves we could obtain the initial speed quite satisfactorily if all the wagons had the same frictional resistances. As that is not the case, however, account has to be taken of the two extreme conditions of maximum and minimum wagon resistance. Particularly does that difficulty arise when there is no retarder situated before the first switch. In that case a good runner, following behind a bad runner, cannot be checked before reaching the switch, and allowance has to be made in the calculation of the initial wagon spacing for the amount the good runner will catch up the bad runner before it reaches the switch.

For obvious reasons, the trains being pushed over the hump cannot suddenly pass from an up grade on to the steep initial down gradient of the hump, and therefore a vertical curve has to be inserted at the summit of the hump and also at other points in the yard where two different gradients meet.

The radius chosen for the vertical curve at the summit has an important bearing on the humping speed, as the difference in time taken by good and bad runners over this zone is very marked. In Fig. 6 will be found a set of curves showing the times taken by wagons, with maximum and minimum resistance, to run over different distances along vertical curves of various radii, and in Fig. 5 curves connecting the radii of vertical curves with the length of curve necessary between the tangents formed by the horizontal at the summit of the hump, and the initial gradient for various values of initial gradient. The smaller the radius used, of course, the less will be the actual length of curves needed and, hence, the less will be the difference in running time between two wagons.

It is also seen from Figs. 5 and 6 that, for any given length of curve, the difference in running time between a good and a bad runner becomes less as the radius of the vertical curve decreases, and that the length of curve decreases as the initial gradient decreases. So that, as the initial gradient is decreased, the time differences over the vertical curve are decreased. On the other hand, the time differences over the initial gradient itself increase as the latter decreases. A compromise therefore has to be made, and, by considering the entire length of track from the summit to the end of the initial gradient, the best combination of radius of curve and value of gradient has to be determined by the construction of time-distance and speed-distance curves, such as those shown by Figs. 4 and 7. From these curves the spacing between wagons at any time can be found. The curves shown are drawn for two wagons, with maximum and minimum resistances. The increase of spacing as they proceed off the vertical curve and down the initial gradient can be clearly seen.



FIGS. 5 AND 6

From this spacing, knowing the length of track circuit, the position of the switches and of the necessary retarders can be determined.

After the first switch, the good runners will have to be retarded to prevent their attaining excessive speed. The problem to be solved here is how to arrange matters so that the good runner is not held in a retarder long enough for a following wagon to catch it up before it is clear of the last clearance point.

It has been pointed out previously that, after having been retarded, the good runner may actually lose time to an unbraked bad runner. That fact is illustrated by Fig. 8. In Figs. 8 and 9 time has been plotted against distance, the distance being taken down one track of an imaginary yard lay-out. The broken line portions of the time-distance curves indicate the time taken by the good runners after having been retarded sufficiently to bring them to

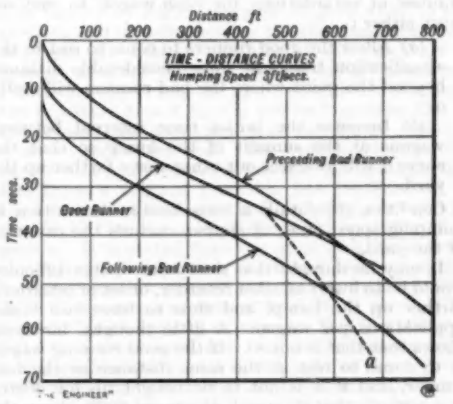


FIG. 8

rest at an appropriate point in the classification tracks.

From the full lines in Fig. 9 it will be seen that, with the retarder in the position shown in full lines, the good runner has to be retarded to such an extent that the following bad runner catches it up before it is clear of the last set of switches. One way of getting over this would be to place the retarders in the position shown dotted, when eight would be required instead of only four. With the retarders in this position, it is seen that there is ample clearance between wagons all through the yard.

An alternative method of overcoming the difficulty, other than reducing the humping speed and thus increasing t_2, without the increase in the number of retarders, is to bring the third set of switches as close as possible to the second set, somewhat after the style of the arrangement shown in Fig. 9. Here we find that the following bad runner does not catch up with the preceding retarded good runner until the switches are cleared.

In the construction of these curves a transition

gradient of 1 in 100 has been put in between the initial 1 in 18 gradient and the final level. That is found advisable in practice, partly in order that the transition between the initial and final gradients shall not be too sudden and cause unnecessary shock to the wagons, and partly to enable the good runners to gain from the bad runners a little of the time that they must lose to them after retardation.

Considering, once more, Fig. 8. Let it be supposed that the distance from the summit of the hump to the farthermost clearance point is 600ft. Then, the good runner must not be retarded to such an extent that the following bad runner will catch it up before it has travelled 600ft. So that, if we take a point on the curve for the following bad runner where it crosses the 600ft. line, knowing the distance in which it must come to rest, we can calculate the speed to which a good runner must have been reduced by the time it reaches this point and, from this, we can construct a new time-distance curve, for the good runner, back from this point. This new curve is shown as a broken line and is labelled *a*. Where this new curve cuts the original time-distance curve for the good runner, is the point at which the retarder should be installed. This is found to be about 460ft. down the yard, by which time, with the track lay-out shown in Fig. 2, for instance, the number of retarders would be excessive. So that, if we are to limit the number of retardations for each wagon to one, we must either :

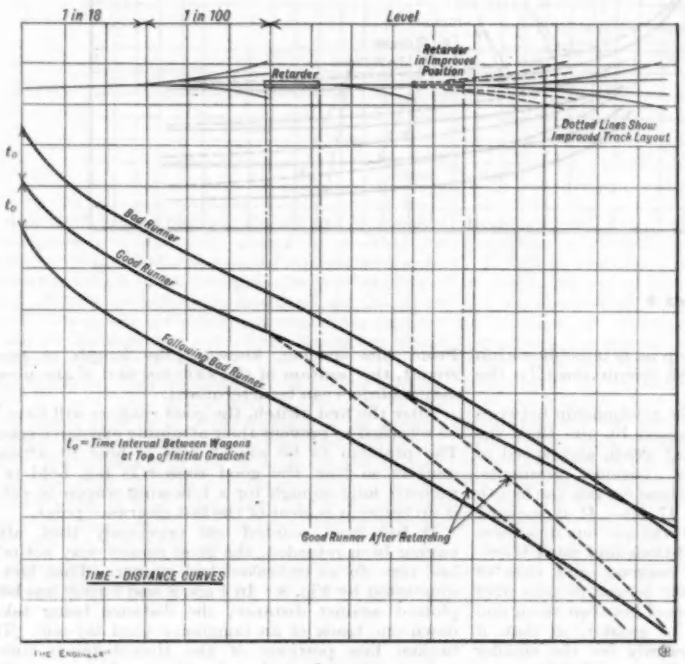


FIG. 9

(*a*) Allow the good runners to come to rest in the classification tracks at some considerable distance beyond the point where the bad runners will stall ; or

(*b*) Increase the initial time interval between wagons at the summit of the hump so that the curve *a* will intersect our other curve farther up the yard.

Condition (*b*) entails a considerable diminution in humping speed, and, of course, curtails the capacity of the yard.

It may be thought that a way out of this difficulty would be to insert another retarder, or set of retarders, farther up the hump, and thus to have two brake applications per wagon. A little thought, however, shows that that is not so. If the good-running wagon is to come to rest in the same distance as the bad runner, and if it is not to be caught up for 600ft., it is obvious that its speed, at a point 600ft. down the yard, is fixed, and that our curve *a* is also definitely fixed. Now the effect of introducing a retarder nearer to the hump would be to bring the curve for the good runner below its present position, so that it would cut the curve *a* still farther down, indicating that the second set of retarders would have to be similarly extended.

From this argument, it will be seen that it is uneconomical to install more retarders than are necessary for the removal of the surplus energy from the good-running wagons.

Thus it would appear that a compromise has to be made between conditions (III.) and (IV.) quoted above. The distance the good-running wagons can be permitted to run in excess of the distance run by the bad runners will depend upon the length of the classification tracks and the speed at which a good runner is to be allowed to collide with a bad runner that may be already standing in the particular siding for which it is intended.

RETARDERS.

The different kinds of retarders now in use are numerous, but they all come under the following main headings :—(i.) Electro-magnetic ; (ii.) electro-pneumatic ; (iii.) all-electric ; (iv.) hydraulic ; of which the last three types all depend upon friction for their braking action.

With the electro-magnetic type, the wheels of the wagons are made to pass between the pole faces of very powerful electro-magnets. The rotation and translation of the wheels in the magnetic field, which is of very high flux density, cause eddy currents to be set up in the wheels themselves, and to a certain extent in the brake beams. In this manner, energy is absorbed from the wagon, which is retarded in an exceedingly smooth and even way. The amount of energy which this type of retarder can remove from any wagon is dependent upon the number of axles with which the wagon is fitted. Owing to its magnetic action, there is no fear of derailment with these retarders, and friction is almost entirely eliminated.

The electro-pneumatic retarder, as its name implies, is operated by compressed air, the valves being controlled electrically.

In the all-electric retarder the pressure is applied, through a toggle arrangement of levers, by electric motors.

The hydraulic retarder is operated on the principle of the Bramah press, the pressure being controlled by means of a lever.

All the last three types are friction retarders and rely upon the pressure applied to the wheel tires for their braking action. That being so, the maximum energy they can remove is constant, and does not increase with the number of axles. There is necessarily considerable shock when a wagon enters an energised friction brake, and there is also a tendency to lift light wagons off the track rails, and in most forms the brake beams are so designed as to ensure that, should this occur, the wheels drop back on to the rails when the wagon is released from the retarder.

A further method of retardation is by means of skids, or skates, which, however, only operate on the leading wheels of a cut, and hence more of them have to be utilised.

The point machines should be as quick acting as possible. Machines designed especially for hump yard working have a time of throw of about three- fifths of a second. It will readily be realised that the quicker the action of the point machines, the shorter will be the length of track circuit required.

Power-operated point machines are far more efficient than those operated by hand, both from the point of view of the saving in labour effected by controlling all the machines from one central point, and on account of the quicker action that can be obtained.

Automatic setting of the points is a great advantage. Some or all of the points in a yard are pre-set before humping is commenced, and, as each cut passes over a set of points, it automatically sets them in the correct positions for the next cut. With this arrangement, an operator in the control cabin can set up all the switch movements before humping starts, and can then devote his whole attention to the operation of the retarders, instead of there being one man on the retarders and another operating the points.

CONCLUSION.

From the foregoing remarks it will be gathered that there are so many variable quantities to be dealt with in hump yard design that many compromises have to be made, and that calculations have very largely to be a matter of trial and error. However, a few of the main points to be borne in mind may be said to be :—

(*a*) The hump must be high enough to ensure that the worst-running wagons, under the most adverse conditions, will run the full distance required.

(*b*) The gradients of the hump must be such that the wagons separate quickly on leaving the summit.

(*c*) The track circuit over the switches should be as short as is consistent with safety.

(*d*) The wagons should be split up into as many streams as possible in the shortest time.

(*e*) The curve and switch resistance should be kept constant for each track.

(*f*) The distance between the last retarders and the farthest clearance point should be as short as possible.

(*g*) Automatic point setting is to be recommended.

Modern Types of Propelling Machinery for Mercantile Marine Use.*

By STERRY B. FREEMAN, C.B.E., M. Eng., Member of Council.

No. II. *(conclusion).*†

OIL ENGINES.

THE difference between the turbine and oil engine in matters of development and standardisation is very great. The steam turbine in its latest form is so efficient that it hardly fears the competition of the gas turbine, and the bigger it grows the less is the fuel consumption per unit of power. It is not tied to one class of fuel. Its power cannot be tested on the test-bed for lack of sufficient boiler power. There are two systems only—reaction and impulse—and they are combined freely in one unit. Practically all engine builders can hold a licence to build the latest type of turbine or can build without a licence.

Every oil engine is tied for satisfactory running and upkeep to a certain fairly narrow range of fuel. The advent of an entirely satisfactory and economical coal-burning engine would be of serious consequence to it. The bigger the oil engine the greater the difficulties to be overcome. With its present power it can be tested on the test-bed. There are, perhaps, five or six original oil-engine builders and a host of licencees. Each produces an engine which is different in some one or more important particulars from the others. The effect of the licensing system has been to drive oil-engine builders into three schools—two-stroke, four-stroke, and opposed-piston—and they each deny salvation to the heretics outside their own particular school.

The first successful ocean-going motor ship of importance, the "Selandia," is still in commission, so it may be said that all motor ships are relatively modern. No one type has become standardised and there appears to be no likelihood of agreement as to which of the various engines is most suitable for general use. From the beginning the obvious weakness of the oil engine was the small output of power per unit of weight, and much of its development has been directed to securing a bigger output from the same weight of material and to reduce its high cost. The possible reduction of fuel consumption, although necessary and desirable, could only be the order of, say, 28 per cent.—from 0·45 lb. per S.H.P.-hour to 0·35 lb. The oil engine has a good Press, and development work is well spread internationally, which, in some measure, accounts for the rapid progress made. All types of oil engine—four-stroke, two-stroke, single and double-acting, and opposed-piston—have benefited by the common stock of knowledge now available. For example, the effects of modification in the shape of the cylinder head and the top of the piston, the angle of scavenge ports, the fuel-valve nozzles, the question of spraying, and of altering the quantities of scavenge air and cooling water, &c., are now well understood. Improvements in the quality and strength of cast iron have made possible the use of higher temperatures and pressures, resulting in higher thermal efficiencies, and the mechanical efficiency has been increased by the adoption of airless injection of fuel—thereby dispensing with air compressors—and by supercharging four-stroke engines. The trunk-piston engine has been helped by the work done on other types with centrifugal cleaning of the lubricating oil, and the wear and tear on all oil engines has been lessened by the use of the same machines to eliminate grit and water. The improvements which have taken place are the result of experiment and operating experience, and in the oil engine small alterations frequently cause great differences in working.

As in the case of the turbine, the use of gearing has been employed to reduce the rate of revolution between the main motor and the propeller, a fluid coupling being employed to minimise the danger of shock to the teeth. Whilst this system permits of fast running, and therefore small and light motors, the total space occupied is greater than with a direct drive, and the following table gives a comparison between two ships, of equal power, but propelled by different types of machinery :—

	"Kota Agoeng" (geared double-acting two-stroke engines).	"Polyphemus" (supercharged four-stroke single-acting engines).
Shaft horse-power	5500	5550
Weight of installation, tons	940	994·2
Length of engine-room, feet	77	50
Number of cylinders	10	12

The four-stroke crosshead engine with its low consumption of fuel and lubricating oil due to positive scavenging and the cooling stroke between each power stroke, has been pitted against the two-stroke engine with its greater output per cylinder, and as the oil consumption does not greatly differ as between the two types, the two-stroke engine has been catching up the others, especially for passenger ships in which the reduced height helps the naval architect. The earlier engines which were fitted in the "Vulcanus"

* The fourth Thomas Lowe Gray Lecture. January 8th. (Abstract).

† No. I. appeared January 15th.

and "Eavestone" were too highly rated in mean indicated pressure and would to-day be run at lower pressures to reduce the temperature stresses. Heat stress is the difficulty, and whereas the four-stroke engine has an idle or scavenging stroke, the two-stroke engine builders have now adopted ports for scavenging and exhaust, thus eliminating the hot exhaust valve in the cylinder head and leaving a strong symmetrical head easy to cool. The four-stroke engine head has now been redesigned and by means of wider spacing of the valves the cooling and strength are improved.

To compete with the greater output of the two-stroke engine the double-acting, four-stroke engine has been introduced and the power thus increased by about 70 per cent. The weight and accessibility of this type of engihe are necessarily not as good as in the case of the single-acting engine. The two-stroke, double-acting engine followed and is now being developed by many builders.

An alternative method of increasing the power of four-stroke engines, which also results in reduced weight and height of the engine, is to build it as a trunk-piston engine and to increase the speed of revolution. This involves giving up the accessibility of the open crosshead type and accepting a somewhat reduced propeller efficiency, but it has found favour in some types of passenger boats.

For some years methods of charging the cylinder with air under pressure have been experimented with. It has been found practicable and economical to increase in this way the weight of air entering the cylinders, and the amount of fuel injected can be increased in the same proportion. What the eventual extent of the increase will be it is not possible to say; but the recent trials of the "Polyphemus" carried out by the Marine Oil-Engine Trials Committee of the Institution show that 50 per cent. is compatible with sound practice. This increase of power is obtained with an air pressure of 4 lb. to 5 lb. per square inch. The fans or blowers may be driven by a motor taking its power from the main switchboard, by exhaust-gas turbines, as in the Büchi and Rateau systems, by chain from the main engine crank shaft, as in Burmeister and Wain's system, or by utilising the lower side of the main pistons as air compressors, as in the Werkspoor system. The type to be adopted depends somewhat on the service and the increase of power required, and also, to some extent, upon the engine arrangement.

From 1912 onwards the opposed-piston type of engine has been built and developed by Messrs. Doxford as a two-stroke single-acting engine and has achieved much success. It will be remembered that next to the Still engine it was shown to have the lowest rate of consumption in those engines tested by the Marine Oil Engine Trials Committee. The straight-through scavenge from ports in the bottom of the cylinder to ports at the top, giving a good fuel consumption, and the airless injection of fuel, together with the exceptionally good balance, are outstanding advantages of this engine. Other features which differentiate it from the majority of oil engines are the low compression pressure—about 285 lb. per square inch—the hot pistons and the hot fresh water circulation system which increases the thermal efficiency and assists rapid starting. The output per cylinder is high, reaching 1300 B.H.P. in later engines. The details of single-acting engines are fairly well known and no fresh design of unusual character has appeared lately.

Since the early days of the heavy-oil engine it has been recognised that eventually the two-stroke cycle double-acting engine would become the standard type for many classes of ships. It is obvious that with an impulse at the top and the bottom of each cylinder during each revolution the greatest amount of work can be obtained for the weight of machinery involved. The Continental builders, A. E. G., Hesselman, Burmeister and Wain, Deutsche Werke, Krupp, M.A.N., Sulzer and Werkspoor, the North-Eastern Marine Engineering Company, and Richardsons, Westgarth in this country, and Messrs. Worthington in America all have a double-acting engine at sea. Certain drawbacks must be accepted as the price of the increased output, *e.g.*, the closing in of the lower end of the cylinder, which restricts facility in dealing with the pistons, covers, and liners, the necessity for piston-rod packing, and the difficulty of ensuring good combustion below the piston. These drawbacks have been tackled, and with the adoption of better materials and designs embodying the requirements found necessary after greater experience of the engines at sea, they have been largely overcome. It is impossible, within the limits of this lecture, to detail the individual peculiarities of each engine, but it can be seen from the number of builders that the double-acting engine is quickly establishing itself.

Fuel Injection.—Perhaps the most important alteration of design that has occurred recently is the change from air to airless injection of the fuel. Messrs. Doxford have used airless injection for many years, Messrs. Scott and Co. have used it in their Still engines, the M.A.N. Company fitted both systems, but it is only in the past two years that Messrs. Burmeister and Wain and Messrs. Sulzer have adopted it. The gain in mechanical efficiency is about 5 per cent., and now that the design is getting down to the bone, as it were, it is a welcome morsel. The saving of weight by the abolition of the air compressor and high-pressure blast air bottles is not great, but the saving in overall length of the engine may be considerable. The first cost of the two types of engine is about the same, due to the high grade of workmanship and material required in the airless injection pumps, valves, and their connections. The injection pressure of the fuel varies widely with the type, from 4000 lb. per square inch in Vickers and Richardsons, Westgarth engines, to 7000–9000 lb. per square inch in Doxford engines. Generally the fuel pump is timed so that the oil is delivered to a simple automatic fuel valve in the cylinder head. In the case of the Doxford engines, however, the fuel valves are mechanically operated and they control the supply of the fuel to the cylinder and spray the atomised oil into the combustion chamber. There appears to be no difficulty in using various grades of fuel oil with specific gravities from 0·86 to 0·94. The airless injection system and the oil engine generally have been much improved by the use of centrifugal separators. As much as 4 lb. or 5 lb. of solid matter and 1 or 2 gallons of water per 10 tons of oil treated is commonly removed. Another economy, especially applicable to passenger ships, tankers, and vessels trading principally in colder waters, is the exhaust gas boiler, which may be fitted to supply water for heating, cooking, washing, &c. In other vessels, such as tramp ships and tankers, where steam may be required for cleaning the holds, the dynamo steering engine and pumps can also be worked by steam from this boiler. No back pressure is set up and the silencers otherwise fitted can be dispensed with. It is found possible to produce about 1 lb. of steam at 100 lb. per square inch pressure for each brake horse-power-hour developed in the main engine. The economy due to saving of auxiliary power can be as much as 4 or 5 per cent.

Few shipowners have made public their repair costs, but the figures given by Major Cripps in 1930 and Dr. Blanche in 1931 show that for a mixed fleet of reciprocating steam, turbine and oil engine vessels the cost of the oil engine repairs was as low as, or lower than, that of the steam-driven vessels. The personal factor has much to do with this matter. Recently I saw some oil engines being overhauled, which had been taken from a comparatively new vessel. They had been damaged by neglect and mishandling to a shocking extent. Similar engines of the same design and power have been running for six years in another ship and have not yet needed any serious renewals. The best machinery in the world is not safe in the hands of incompetent or careless engineers, and a tribute should be paid to the way in which our engineers generally adapt themselves to all classes of main and auxiliary machinery at sea, often with little previous training and sometimes with little support. In the matter of reliability, it is the case that apart from experimental work there is nothing to choose between the steam turbine and the oil engine to-day.

Experience with oil engines teaches that certain troubles are inherent in an internal combustion engine. Cracked cylinder heads, cracked and worn liners, cracked and burnt pistons, leaky and burnt valves, leakage of cooling water into cylinders and crank casings, broken crank shafts, failures of white metal in bearings, and inadequate holding-down bolting arrangements were some of the difficulties of the earlier days. To-day these are still troubles, but they are mostly due to designers or operators attempting to take more out of the material of the engine than it can stand, or to some defect of workmanship.

It is difficult to say what the life of the various parts may be, but the appended list of main engine renewals may be of interest.

Ship.	Built.	No. of cylinders	Cylinder heads.	Cylinder liners.	Pistons.
"Tantalus" ..	1923	16	—	7	—
"Medon"	1923	8	—	6	—
"Eurymedon" ..	1924	16	2	—	—
"Peisander" ..	1924	16	1	—	—
"Alcinous"	1925	16	6	—	—
"Prometheus" ..	1925	16	1	1	—
"Phrontis"	1926	16	2	—	—
"Orestes"	1928	16	4	—	—
"Idomeneus" ..	1929	16	—	—	1

Metallurgy.—Progress in marine engine design and construction has been greatly assisted by the many advances made in metallurgy during the last thirty years, and further developments now seem to depend largely upon the success of further research in this field.

Turbine blading is, of course, liable to erosion and corrosion, the extent varying with type of turbine conditions of working. In Dr. Cook's recent experiments, whereas blades of mild steel, cupro-nickel and tungsten steel were more or less rusted and eroded, Hecla/A.T.V steel was unattacked. As temperatures increase, cast steel turbine casings have to be used further along the turbine. As already pointed out, the phenomenon of creep has caused the employment of special steels such as Hadfield's Era/131, of which the creep stress at a temperature of 1000 deg. Fah. is stated to be five times that of carbon steel.

In the condenser the problem of leakage of sea water into the boiler feed water through the failure of the condenser tubes appears to have been solved. The method adopted in the Navy and in the more important mercantile steamers is to use tubes of cupro-nickel, Monel metal, or other special alloys, but containing not less than 30 per cent. of nickel. This is sufficiently hard to resist corrosion and erosion, air impingement, and other attacks. The other means is to employ an alloy containing 76 per cent. copper, 22 per cent. zinc, and 2 per cent. aluminium. This rapidly develops a protective coating of aluminium oxide, which, so far as three years' experience goes, is equally successful in resisting attack and is now being largely taken up for marine use. One of the causes of failure in the old brass tube was dezincification or the absorption and redeposition of copper. It was found that an addition of 0·2 per cent. of arsenic inhibited this action, and the inclusion of this element is a wise precaution. The boiler has equally benefited, especially in the use of the material for the water-tube boiler. Drums are now formed from the solid ingot, eliminating the riveted seams and ends. The heat-resisting properties of steels of low carbon content are improved by the addition of small amounts of molybdenum and copper, and material of this quality is used in the manufacture of tubes for water-tube boilers. Mechanical stokers are now fitted with grate plates, tuyeres, and slicing bars of heat-resisting steel. The oil engine has been especially helped by the improved foundry practice which has made it possible to produce with certainty cast iron in its pearlitic form. The cylinder heads, liners, pistons, piston rings, and valves, subjected as they are to great heat, are now made of pearlitic cast iron with a great increase in their durability, strength, and wearing properties.

Fuel and its Effect on the Type of Engine.—Figures taken from Lloyd's Register of Shipping show that the use of oil, either for the turbine or oil engine driven ship, is more and more superseding coal.

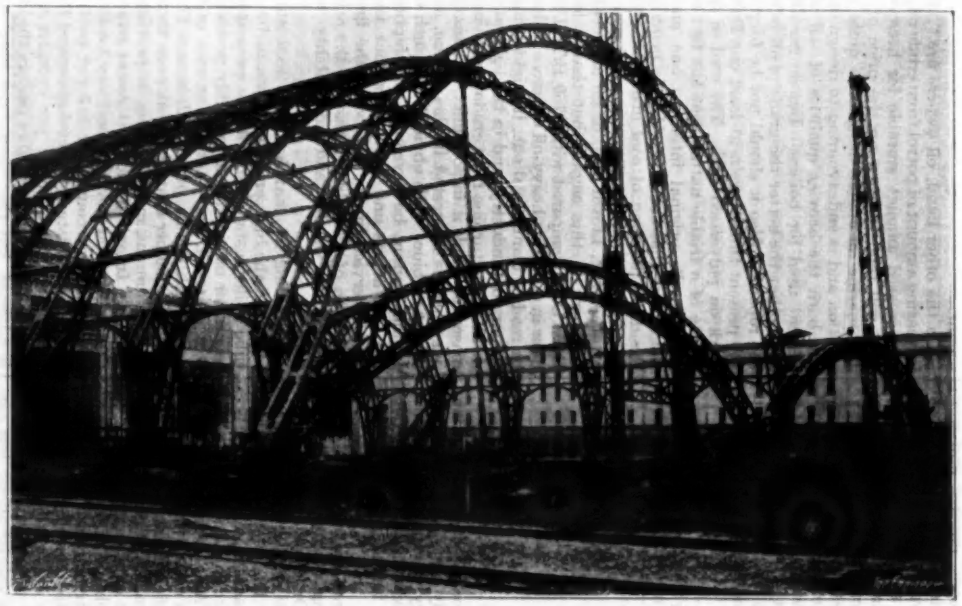
It is naturally the pleasant and popular thing in this country to express optimism as to the future of coal, and especially of the mechanical handling and firing of coal, and from the technical point of view this optimism may be justified. By assuming that oil is two or three times as dear as coal, balance sheets can be drawn up to show that the reduced consumption of the oil engine is set off by the increased cost of its fuel. Unfortunately, a steamship which has a reasonably good cargo on board will need to replenish its bunkers while on a long voyage, and the price of bunker coal in ports where it has to be imported—*e.g.*, Port Said, Singapore, &c.—is very different from that at home, near our coalfields. The oil owners know from first-hand experience the relative values of the two fuels, and how far they need to reduce their price to compete with the world prices of coal. The question as to which fuel should be used is much more a transport than an engineering question to-day. If the shipowner can afford to carry the extra weight and can give up the extra space that coal requires, he will probably find that this consideration is the dominating one. The length of the voyage between terminal ports comes into consideration here. For an equivalent weight coal occupies about 17 per cent. more space than oil, and the transport of the same number of heat units requires 50 per cent. more weight.

On the other hand, oil owners are "cracking" an increasing amount of petrol from crude oil, and leaving a decreased amount suitable for heavy-oil engines. This will tend to keep up the price of engine fuel. The marine oil engine designer is quite alive to this position and is endeavouring to design engines which can burn the heavier qualities of oil which are at present used for boilers. But so far all experience shows that the better the grade of oil burnt the fewer the repairs. Also it should not be forgotten that at the present time there is at least one Diesel engine at work on pulverised coal. The coal in question is a lignite of a friable nature, but the fact remains that Dr. Diesel's original intention has materialised to the extent that some 150 H.P. is being produced by the direct burning of coal inside the cylinder of an engine. It is stated that any good coal, bituminous or otherwise, brown coal, or oil and coal mixed, can be burnt in this engine, but that it requires 8000 B.Th.U. as compared with 6750 B.Th.U. per B.H.P.-hour in oil with a heavy-oil engine. If this system can be made a commercial one, it might bring some relief to our coal industry, and in the light of the development of the turbine from crude beginnings there is no reason to think it impossible. The marine engineering world is interested in this engine, as in the gas-driven turbine. It is obvious that such experimental engines cannot be developed on shipboard with all the limitations and drawbacks that the conditions of sea service imply, but when the first and great condition of reliability is assured the other points of cost, space, weight, and adaptability will be dealt with.

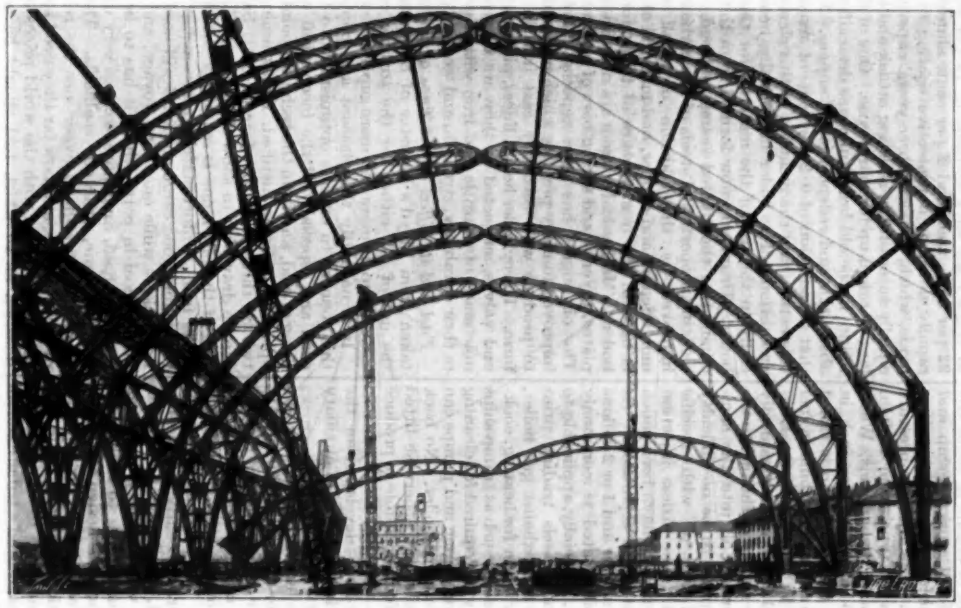
Conceding all that has been said and written in favour of the high-pressure steam turbine and water-tube boiler installation with its present-day developments for use in the more highly powered ships, it is still using oil, and that at the rate of 0·6 lb. compared with 0·4 lb. per S.H.P.-hour. That is to say, it is using 50 per cent. more oil, even though the load, apart from the main engines, is provided for by oil engines. In one of the most recent large steamships, it is understood that the auxiliary load carried by oil engines only accounts for 1·5 per cent. of the fuel. In the present stage of development of the oil engine, the limit of safe power per cylinder is apparently 1000 B.H.P., and for higher powers the steam turbine is adopted, but that should not blind us to the fact that coal is barred for such high-powered ships and

PLATFORM ROOF OF THE NEW CENTRAL RAILWAY STATION AT MILAN

(*For description see opposite page*).



ERECTION OF CENTRAL ARCHES



ERECTION OF ARCHES OF SIDE BAY

THE CENTRE BAY IN COURSE OF ERECTION

THE CENTRE BAY COMPLETED

that engine fuel oil is necessary, in addition to boiler fuel oil to run it.

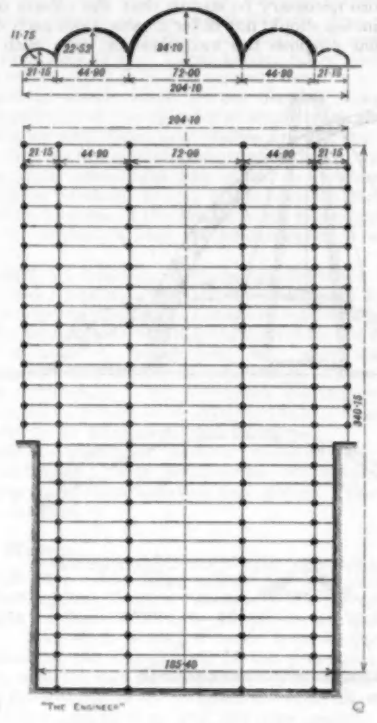
Summary.—Marine machinery has reached a most interesting stage of development. On the one hand, the conjoint demand for economy and for increased speed has forced the adoption of systems hitherto felt to be too risky for marine use; on the other, the tendency for all prime movers to develop eventually into the most simple form is at work. The limitations of bunker space and weight have a decisive bearing on the duel between coal and oil. The reciprocating steam engine, even when aided by efficient valves, superheating, and an exhaust turbine, cannot better the performance of a turbine and is more complex. The turbine working at high pressure with highly superheated steam generated in water-tube boilers, complex systems of feed and air heating, and meticulous care of the purity of feed water, is clearly the right choice for the highest powers. The oil engine, which is more suitable for the moderate and lower-power installations, has increased its vogue, and the use of pressure induction or supercharge has helped it greatly. The two-stroke, double-acting engine is now in use, and is doing well. Oil fuel is at present a necessity for passenger ships; pulverised coal is not making the rapid strides anticipated; and mechanical grates appear the more promising way to burn coal. Mechanical gearing is not yet ousted by electrical transmission, but modern sensitivity to vibration, even of small order, is having an effect where passenger ships are concerned, and may outweigh the greater economy of mechanical transmission.

The New Central Railway Station at Milan.

THE completion of the new railway terminus at Milan has rightfully claimed the attention of railway engineers all over the world, not only on account of the magnificence of the station building itself, but also because of the many unusual features and the gigantic dimensions of the structure. That structure comprises the station building itself and the track, which is raised 25ft. above street level. The area available for platforms and lines has a length of 5900ft. and a width of 660ft.

The station building consists of a main portion, 700ft. long, and two lateral wings, each 500ft. long and 33ft. wide. At the centre the main body projects towards the Piazza Andrea Doria over a length of 610ft., and has three wide openings, each 30ft. wide and 54ft. high. A carriage drive, 93ft. wide and 91ft. high, traverses the whole length of this projecting portion. The carriage drive is divided into two sections by a wide footway which leads from the central openings from the Piazza into the booking hall. One of these sections is for incoming carriages and the other for outgoing carriages. From the carriage way the booking hall is reached. It is 210ft. long, 110ft. deep and 139ft. high, and is covered by a glass roof. The ticket counters are placed along the wall facing the entrance. The decorations of this hall are of an unusual elaboration, all the walls being covered with rare coloured Italian marbles and ornamented with basso-reliefs and statues. To the right and left of the booking hall are the luggage rooms, two on each side, with subsidiary offices and service rooms. The luggage rooms are lined with rose-coloured granite and marble. Two staircases lead from the booking hall to the main platform level, which is 25ft. above the street level.

The circulating area to which the staircases lead is a structure 710ft. long, 73ft. wide, and 83ft. high. On one side are the waiting rooms, restaurants, tourist and inquiry office, post-office, &c. From the opposite side access is gained through control gates to the platforms, which serve twenty-two passenger lines. Two further lines are reserved for shunting purposes. Each line has two platforms, of which one, exclusively reserved for passengers, is 24ft. wide, while the other, for service purposes, is 13ft. wide. These widths are increased to 28ft. and 18ft. respectively for those platforms which carry the roof supports. At the head of the platforms three large luggage lifts are installed, one for incoming, one for outgoing luggage, and the third for "grande vitesse" goods. At the other end of the platforms special lifts for mail bags are installed, and are in direct communication with the mail sorting office. The length of the platforms varies from 1000ft. to 1070ft.

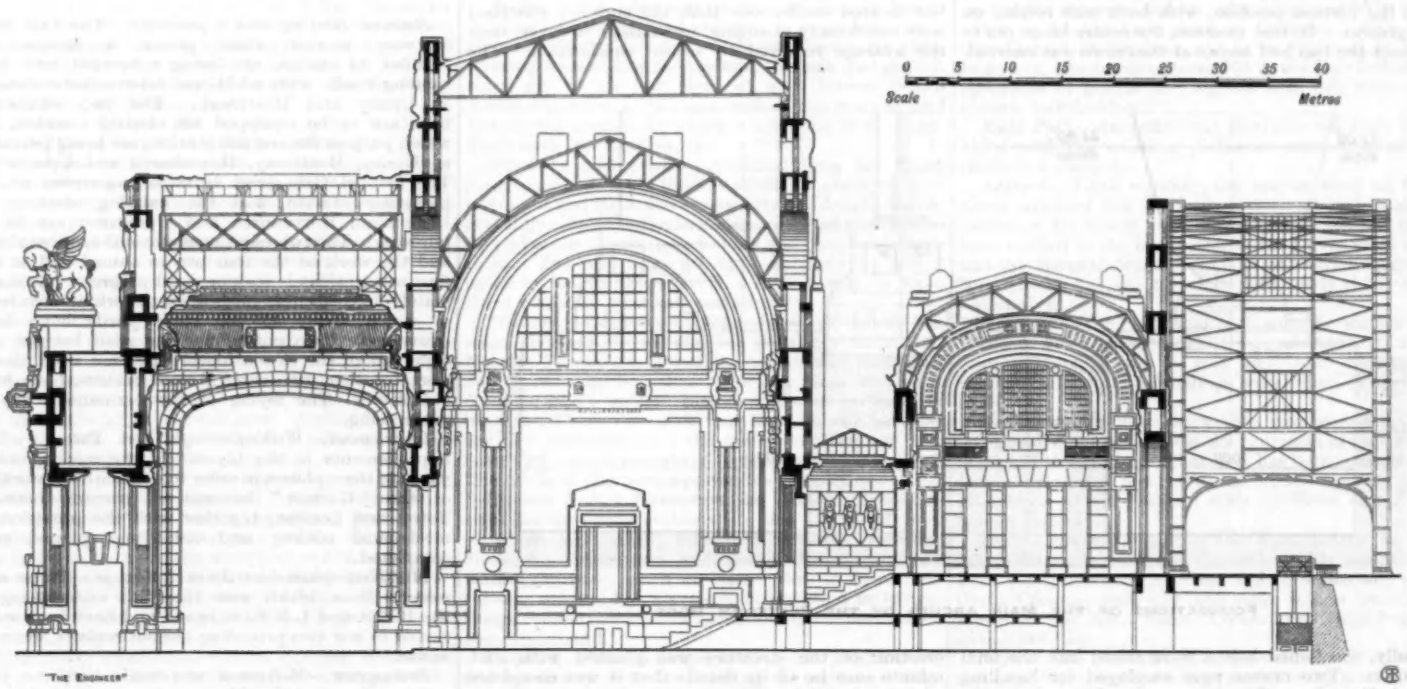


LAY-OUT OF PLATFORM ROOF

The platform roof is 1125ft. long. It consists of five glass-covered arches, of which the centre arch has a clear span of 238ft. The two adjoining arches have a clear span each of 148ft., and the two outer arches have each a span of 40ft. where they come within the lateral wings of the station building, and of 70ft. beyond these wings. The total covered area is about 665,000 square feet. In addition to the usual hinges at the base and crown of the arches, two further hinges were introduced at the junction of the centre arches with the lateral arches. This system of construction eliminated indeterminate stresses, and, further, greatly facilitated the erection of the arches. The purlins are disposed radially and their section has been varied in accordance with their inclination to the vertical axis. The purlins are connected to intermediate jack arches placed at 2·65 m. from the main arches. The purlins of the three large bays are composed of double channels with webs varying from 400 mm. by 10 mm. to 550 mm. by 12 mm., and with four flanges measuring in section 75 mm. by 100 mm. by 10 mm. in the two 148-foot bays, and 80 mm. by 120 mm. by 10 mm. in the central bay. The intermediate jack arches for these three bays have webs of 400 mm. by 10 mm., and four flanges of 75 mm. by 75 mm. by 10 mm. The feet of the arches for the larger bays rest upon a block of solid granite measuring 1 m. by 2 m. by 0·80 m. for the centre bay, and 1 m. by 1·70 m. by 0·80 m. for the two adjoining bays. Cast steel plates are inserted between the arch feet and the foundation, and are provided with wedges to regulate the level of the arches.

The immense dimensions of the structure demanded a very careful study of all its details. Past experience had shown that the hot smoke and steam from the engines detrimentally affected the steel work and that the use of thin structural members should be avoided, even when the stress calculations would warrant the employment of thicknesses below 10 mm. For the same reason, all small trellis work was eliminated. Only the arches of the three larger bays are in lattice girder construction. The exclusion of small trellis work has an æsthetic advantage, inasmuch as it avoids an unsightly entanglement of many small members and produces a pleasant simplicity of line. The calculations for the roof structure were based upon two assumptions. First, a vertical uniformly distributed load of 120 kilos. per square metre was assumed; secondly, the single units were calculated for a vertical load of 50 kilos., and a simultaneous horizontal wind load of 150 kilos. per square metre projected.

Nearly half the roof is covered with wired glass panels set in special frames without putty. These panels have a width of 6·75 m. and are divided into ten equal panes between the jack arches. The frames in the two outer bays are covered with lead as a protection against corrosion, which, because of the smaller height of the bays, would, it was anticipated, occur more readily in them than in the larger and higher bays. In addition to the longitudinal clerestories, two series of large, partly-glazed lunettes have been provided as part of the ventilating system. In order to facilitate the uptake of smoke electric fans have been installed in the smaller bays. Before material for filling the blind sections of the roof was chosen, protracted experiments were made with corrugated and pressed sheets of "Armco" iron, and other rust-resisting metals, "Eternit" sheets, sheets of reinforced pumice-stone compound and other materials. It was finally decided to use specially-prepared thin sheets of reinforced cement provided with projecting ribs. In comparison with other materials these sheets are somewhat heavy, weighing 45 kilos. per square metre, but, besides being very resistant, they are cheap. The bays were tested immediately after the erection of the framework. For this purpose bundles of rails corresponding to the weight of the covering material, and the wind and

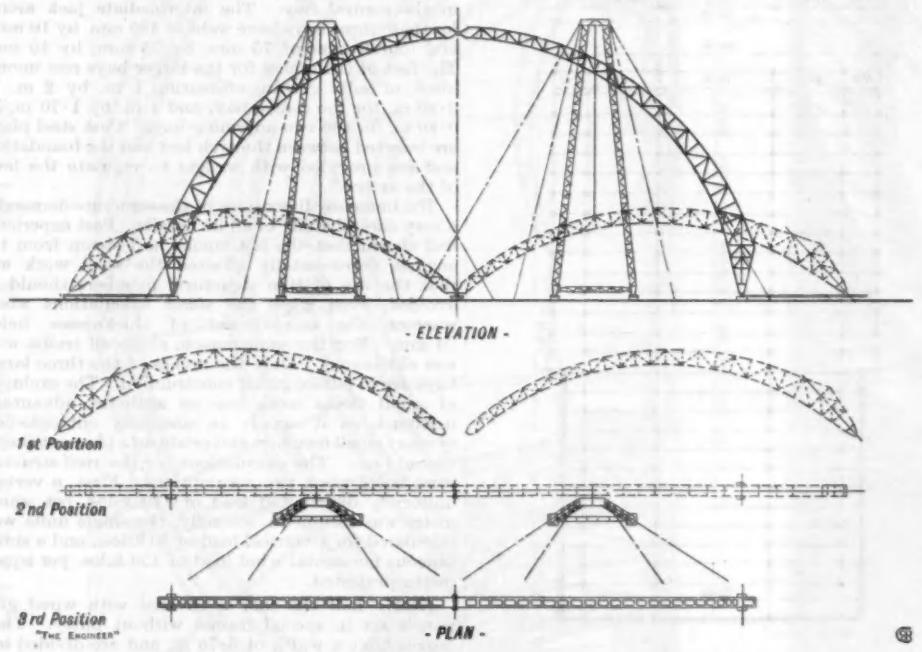


SECTION THROUGH THE STATION BUILDINGS

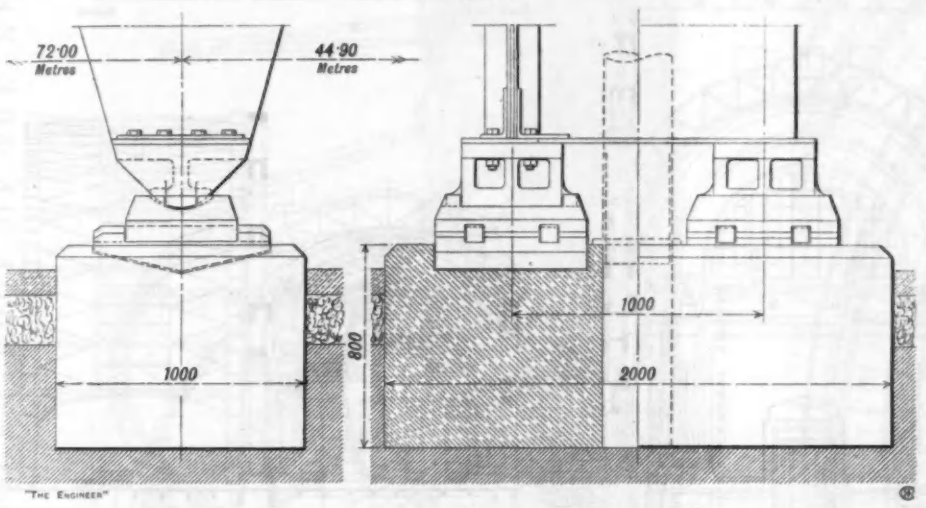
other loads, were suspended at the junctions of the panels and arches. For example, the arches of the central bay were stressed by means of twelve loads, varying from 13 to 17 tons, or a total of 182·6 tons. The vertical deflections at the crown and at intermediate points were measured by fleximeters, the rotation about the hinges at the base was measured by clinometers, and the horizontal deflections at the junction hinges of the lateral arches were read with a theodolite. At full load, the vertical deflection at the crown of the central bay was 61 mm., the rotation at the junction hinges was 5′ 45″, and the horizontal deflection was 19 mm. The arches of the two 148ft. lateral bays showed an average vertical deflection at the crown at full load of 15 mm.

All the various members composing an arch were brought from the works to the site in sections as big as the capacity of the railway trucks permitted. These sections were laid out on the ground for the completion of the riveting. When finished, the two half arches were lying on their sides on the ground with their bases on the axis of the final position of the completed arch. The half arches were then raised into the vertical position, with both ends resting on the ground. In that position, the centre hinge pin to connect the two half arches at the crown was inserted. Finally, the joined halves were raised into the final position. Two cranes were employed for handling the half arches. They were placed at about the middle points of the half arches, and the lifting was regulated in such a way that the ends rested on the ground whilst approaching each other during the lifting process. In order to facilitate the sliding movement of the ends on the ground, sledges were constructed upon which the bases rested. Traction was applied to the sledges to facilitate the lifting operation. Following the completion of the erection, the sledges were removed and the bases of the arches fixed to the foundations. In the case of the lateral 148ft. bays, the arches rested during the lifting process with one end on the ground. The other end, which was to be connected to the corresponding arch of the central bay at a height of about 10 m. from the ground, was lifted free of the ground at the outset, and remained in the air until the other end, provided as before with a sledge, was in the correct position. The arch was then connected by means of the joint hinge to the central arch.

The lifting of the lateral arches was an easier matter than that of the central arches. As already said, the extremities of the central arches remained on the ground during the lifting operations. The danger existed that one of the lifting winches might exert a much greater effort than the other. It was therefore necessary to ensure that the efforts of the two winches should not differ greatly from each other. For that purpose the two winches were each connected to an asynchronous motor of 22 H.P. and, in order to ensure that the efforts of the two winches should be as nearly as possible uniform, a resistance was inserted in each rotor. This resistance was such that in the event of one winch becoming overloaded, its motor, absorbing a greater current, would slow down, and thereby allow the other motor to re-establish the equilibrium of the two efforts. This method proved fully successful. Ammeters inserted in the motor circuits indicated by their continuous but limited oscillations that the currents absorbed were continually changing, remaining, however, near the average required to secure equilibrium. The erection of the structure was planned with such minute care in all its details that it was completed without the slightest hitch or accident.



METHOD OF ERECTING THE MAIN ARCHES OF THE PLATFORM ROOF



FOUNDATIONS OF THE MAIN ARCHES OF THE PLATFORM ROOF

The lay-out of the station is characterised by the provision of two central groups of four outgoing and four incoming main lines to feed the platforms, all of them having a straight run into the station. Five separate groups of carriage and marshalling sidings have been provided. The central group has nineteen lines, of which eleven pass over pits. This group is equipped with an electric traverser, and adjoining it are large carriage repair shops for running repairs, &c. A circular line enclosing this group establishes connection on one side with the new goods and marshalling yard at Lambrate, and on the other side with Musocco. Connection with the locomotive depôt at Greco Milanese is established by two special engine lines, which are independent of the other lines. The two eastern groups of sidings are reserved for slow trains from and to the eastern and northern direction, and contain eleven and twelve lines. The two western groups of eleven and nine lines serve for slow traffic in the west and south directions. A double crossover connects all the sidings with the platforms.

For the purpose of handling the very considerable amount of "grande vitesse" goods traffic in such a way as not to interfere with the passenger traffic, a special "grande vitesse" and mail station has been constructed at the street level underneath the raised platforms and tracks. This station has an area of 240,000 square feet. Connection with the main platforms is provided by four truck lifts, each of 45 tons capacity. The loading and unloading lines are laid parallel with the longitudinal axis of the station lay-out, and connection between the lines is established by a sunk traverser at the south end and a surface traverser at the north end. The entire construction at the street level is in concrete, including the roof, which has to support the tracks overhead.

The signalling installation is of the all-electric interlocking type, built by the Compagnia Italiana Westinghouse. There are seven cabins containing nine interlocking machines, controlling 1140 levers, by which 586 switches, 227 dwarf signals, and 105 semaphore arms are operated. The signals and switches are controlled by means of D.C. at 110 volts, whilst A.C. at 110 volts is used for the indicators. The power required is supplied by two sub-stations, each containing two identical 100-kVA sets—one as reserve—composed of an internal combustion engine, a dynamo and an alternator.

The completion of the new station represents the most important part of the reorganisation of the entire Milan railway services. The scheme includes the construction—now nearing completion—of a great marshalling yard and goods station at Lambrate capable of handling 4000 trucks per day. The total cost of the whole scheme will be well over £11,000,000. We are indebted to the Director-General of the Italian State Railways, Signor Luigi Velani, for his assistance in the compilation of this article, and for the original photographs and drawings from which the illustrations accompanying it and those on page 100 have been reproduced.

Railways in 1931.

BY the continued courtesy of the chief engineers, we are enabled to give the following report of the civil engineering activities of the British railways during the past year.

London, Midland and Scottish.

Between Barking and Upminster.—The two lines of way between these points, a distance of 7 miles 65 chains, are being converted into four running roads, with additional intermediate stations at Upney and Heathway. The two additional lines are to be equipped for electric traction, for which purpose electric sub-stations are being provided at Upney, Heathway, Hornchurch and Upminster. The halt at Gale-street is to be converted into a passenger station, and the existing stations at Dagenham, Hornchurch and Upminster are to be improved. The two additional stations are completed and the work at the four others named and at the four sub-stations is making good progress. Approximately 388,000 cubic yards of earthwork are involved, of which about 335,900 cubic yards have been excavated. Two out of the ten road bridges and eight out of the eleven footbridges that need alteration, together with three stream bridges, have been completed. The laying of the permanent way is progressing.

Cricklewood, Wellingborough and Toton. — The improvements in the lay-out of the motive power yards at these places, in order to deal with the working of the "Garratt" locomotives running between Toton and London, together with the provision of mechanical coaling and ash-lifting plants, were completed.

Mid-Nottinghamshire Joint Railways.—These new mineral lines, which were the joint undertaking of the L.M.S. and L.N.E. railways, and have been mentioned in our two preceding annual reviews, are now in use.

Bromsgrove.—Reference was made herein a year ago to the considerable improvements that were being carried out in the 15½ miles between Blackwell and Abbotswood Junction. Of the work then remaining to be done, the refuge siding on the down side at Blackwell has been converted into a running loop and the widening between Bromsgrove and Stoke Works Junction will shortly be begun.

Ambergate.—The two additional lines for the 1¼ miles in the approach to Ambergate from the Derby direction, referred to in our annual article for 1930, were brought into use on December 13th. The work necessitated the opening out of Longlands tunnel, 101 yards long, and the widening of two bridges over the river Derwent.

Carlton Sidings.—For the new motive power depôt at this point, which is between Cudworth and Royston,

35,300 cubic yards of filling have been deposited, and the engine-shed and permanent way are progressing.

Mirfield.—The provision of two additional lines through this station, a distance of 1900 yards, and of twelve additional sidings to accommodate 622 wagons, will be completed early this year.

Wakefield.—The additional marshalling sidings at Crofton Junction, mentioned herein a year ago, are finished, and the enlargement of the motive-power facilities at Wakefield approaches completion.

Between Stockport and Buxton.—The permanent way for the new up and down loops, each ¾ mile in length, at Hazel Grove, and for the two, ½ mile long, at Dove Holes, is being laid.

Manchester South Junction and Altrincham.—The electrification of this line, which is owned jointly with the London and North-Eastern, came into use on May 11th.

Fleetwood.—The great improvements here, in order to deal with the increase in the number of the trawlers using the fish dock, are completed.

Paisley.—The re-signalling of the goods lines between Paisley and Pollok Junction, so as to carry passenger trains, was completed.

London and North-Eastern.

King's Cross, Hornsey and Ferme Park.—The improvements in the locomotive yards at the two first-named places and the additional sidings at Ferme Park, which will accommodate 523 more wagons, were completed.

Manchester District.—The new marshalling yard between Dinting and Mottram is now half finished. It is to have eight reception sidings, each of eighty wagons capacity, and twenty marshalling sidings, each of sixty-five wagons capacity. The opening out of the two Hattersley tunnels, about 100 and 266 yards in length respectively, was completed. The existing locomotive yard at Gorton is being rearranged. The new work includes the provision of an automatic coaling plant. The new goods depôt at Ashburys was brought into service.

Frodingham.—The new locomotive depôt approaches completion. There are an engine shed, holding twenty locomotives, built entirely of reinforced concrete; a turntable, 70ft. in diameter; mechanical coaling plant; electrically operated wheel drop, and a water tank of 50,000 gallons capacity.

Temple Mills.—The new up goods line from Copper Mill Junction, through Lea Bridge Station to Temple Mills North Junction, with the eight new sidings, was brought into use. A hump has been provided on the down side.

Romford Junction and Shenfield.—In this length of about 7 miles work to be done was, first, the widening to four roads of the double line between Romford Junction and Romford Factory Junction, and, secondly, a similar widening thence to Shenfield. The former work was finished during the year and a contract has been let for the latter. It includes an extension of the stations at Harold Wood, Brentwood and Shenfield, and a burrowing junction at the last-named in order to carry the line to the Southend branch clear of the main line.

Parkeston Quay.—The existing quay is being extended for a length of 1200ft.—sufficient to berth three ships—and additional marshalling sidings and connections to suit are being provided. A new transhipshed, Customs offices, &c., are being erected on the quay.

Cambridge.—The locomotive depôt is being enlarged and improved. The work includes an extension of the engine shed; an automatic coaling plant; a turntable 70ft. in diameter, and an electrically-operated wheel drop.

Additional Loops.—The work of providing additional loops between London and Cambridge and between Cambridge and Spalding, mentioned herein a year ago, made progress. These loops will enable the main line to be cleared more quickly for faster trains to pass, and for the use of heavier engines and longer goods and mineral trains.

Whitemoor Yard.—It was stated in our annual article twelve months ago that the up marshalling yard, equipped with wagon retarders, was being supplemented by a similar yard on the down side. The latter is to have ten reception roads and forty marshalling sidings. The existing down goods yard, when altered, will have two reception lines and eleven marshalling sidings. About 75 per cent. of the work is completed.

York and Northallerton.—Three separate widenings of the main line between these points are in hand. For the conversion into four running roads of the double line between Skelton Bridge and Beningbrough the earthwork was completed. Between Alne and Pilmoor there is to be one additional line on the down side and the contract for it has been let. From Otterington to Northallerton the existing double line is to be extended by an additional road on each side. Part of the work is an important burrowing junction at Northallerton, which has been completed, while the earthwork for the remainer of this widening nears completion.

Darlington.—The important bridge over Parkgate, at the north end of the station, is being reconstructed so as to provide a total width of roadway of 70ft. The existing south abutment will remain, but a new north abutment is being built in a trench behind the existing one.

New shops for the District Engineer, to be known as the Bank Top Permanent-Way shops, are being constructed. They will consist of two main blocks of buildings, in steel frame construction and brick walls. One of the shops is practically completed.

Hartlepool.—The new reinforced concrete water tower, mentioned herein a year ago, was completed during the year. It has a capacity of 20,000 gallons, and is required in connection with the accommodation for 250 additional wagons of coal awaiting shipment.

Coaling Plants in the North-Eastern Area.—New mechanical coaling plants, in reinforced concrete, are being provided at York, Leeds, Selby and Hull. They will be ready for use at an early date.

Doubling Single Lines in the Scottish Area.—On the conversion of the 4½ miles of single track between Inverkeilor and Usan into double line all the earthwork and bridge construction was finished, and the laying of the permanent way is now in progress. On the similar work on the 1¾ miles between Montrose and Hillside some of the bridge work was completed, and the earthwork and the construction is well in hand.

Increased Locomotive Facilities at Thornton, Edinburgh and Glasgow.—Most of the earthwork for the new locomotive depôt at Thornton was carried out, and the foundations below ground level for the engine shed, workshops, engine pits, &c., were finished. A contract was let for the buildings. Turntables of 70ft. diameter, to accommodate the largest type of locomotive in use, have displaced tables of smaller dimensions at Edinburgh and Glasgow.

Mallaig.—Improved harbour facilities are being provided here. They involve the extension of the existing pier accommodation and jetties. The work nears completion.

Great Western.

Paddington.—The large scheme for improvements at Paddington Station includes the giving of a length of from 1000ft. to 1240ft. to all the platforms. Nos. 6, 7, 8 and 9 have been lengthened, and some of the remodelling of the permanent way at the western end is completed. The enlargement of the general offices at the eastern end of the station approaches completion, and the new parcels office at the western end is well advanced.

Acton.—The large concentration yard, which is to accommodate 960 additional wagons, will soon be ready for use.

Between Didcot and Swindon.—The work of supplementing the loop on the up side between Wantage-road and Challow by a down loop and of converting those two stations, and that at Shrivenham so as to have four running roads through them, made progress. A new locomotive depôt is being provided at Didcot, and the approach from the east at Swindon is being improved.

Bristol.—The passenger station at Temple Meads is being remodelled and enlarged in accordance with the particulars related in our annual article for 1930. In order to facilitate the working through that station there are to be four lines of way betwen South Wales Junction, at the east end of the station, and Portishead Branch Junction, a distance of 2½ miles. That work is well advanced.

Westbury and Frome.—Avoiding lines are being constructed at both these stations in order to give a straight run for express passenger and freight trains, and thus eliminate the reduction in speed now necessary over the curves approaching and passing through them. The new lines are approximately 2¼ and 2 miles in length respectively. It is hoped to have them ready for next summer's traffic.

Taunton.—Between Cogload Junction, where the main lines *viâ* Bristol and *viâ* Westbury unite, and Norton Fitzwarren Junction, where the Minehead and Barnstaple branches leave the main line, is a distance of 7¼ miles. Included therein is Taunton Station. There are to be four lines of way between the two junctions, and the station at Taunton will have its accommodation considerably increased. The whole of the work approaches completion.

Between Norton Fitzwarren and Exeter.—There are eight intermediate stations on this length of line, of which Wellington, Sampford Peverell, Tiverton Junction, Cullompton and Stoke Canon, together with Exminster, south of Exeter, are to have four running roads. The necessary new station buildings, bridge reconstruction and alterations to the permanent way are in hand.

Paignton.—The passenger station has been altered and provision made for stabling an additional fifty coaches. A new goods yard has been laid out, and a brick-built goods shed has been erected nearly 300ft. long, and additional sidings for goods traffic formed on it.

Carnon Viaduct, Perranwell.—The replacement of this timber viaduct on the Falmouth branch by one with masonry arches and brick piers progresses. It is 766ft. long and has twelve spans.

Banbury.—The hump shunting yard, with accommodation for between 800 and 900 additional wagons, was completed during the year.

Lapworth and Olton.—The railway between these points, a distance of about 8½ miles, is being widened, in order to carry four instead of two lines. The work approaches completion.

Severn Tunnel.—In the Severn Tunnel two further lengths of 29 chains and 15 chains respectively, including the Sea Wall and Sudbrook ventilating shafts, were cemented. This work, in all, involved the drilling of 4223 holes and the injection of 8132 tons of cement. It has now been established that since the work was completed there has been a definite reduction in the amount of pumping required.

Severn Tunnel Junction and Rogerstone.—The marshalling yard at the former place has been enlarged in order to give accommodation for 1529 additional wagons, and a hump shunting yard has been provided at Rogerstone to deal with 400 additional wagons.

Cardiff.—In connection with the remodelling of the main line station, the new carriage shed at Canton, mentioned herein last year, was completed. The widening of the bridge over the river Taff, together with the work on the remainder of the bridges between Cardiff and Ely, approaches completion, and the quadrupling of the main line for 1 mile up to Penarth Junction is well advanced.

Carmarthen.—The original bridge carrying the Aberystwyth single line over the river Towy has been reconstructed after sixty-seven years' service. It had timber trestles and wrought iron girders. In reconstruction one of the new girders was made of sufficient strength to form the centre girder for a double-track bridge when the line has to be doubled.

Southern.

Old Kew Junction and Brentford.—The provision of an additional running road between these points, which are about ¾ mile apart, was begun last year.

Shawford and Eastleigh.—The quadrupling of the line, 2 miles 62 chains in length, which was mentioned in the two preceding Annual Articles, was completed early in the year.

Exeter, Queen-street Station.—The modernisation of this station progressed. New buildings are being erected at platform level and a new main block built at street level.

Bricklayer's Arms and Willow Walk.—The goods yard of the former South-Eastern and Chatham Company at Bricklayer's Arms and that of the Brighton Company at Willow Walk are practically side by side. The work of combining them in one yard is in hand. Part of the scheme is a large extension to the outward goods shed on the Willow Walk side, which, when completed, will be the largest shed of the kind in London.

Electrification on the Brighton Line.—The electrification of the line to Brighton and Worthing from the terminus of the London suburban electrification at Coulsdon made good progress. The first section to be opened will be to Hayward's Heath. In anticipation of that event, the station at Hayward's Heath is to have four running lines, instead of two, and two island platforms. New station buildings on the down side and considerable extensions to the goods yard are part of the scheme. Colour light signals are to be provided on all the lines south of Coulsdon. The five signal-boxes at Brighton are to be replaced by one large box, which will contain 225 levers for all-electric operation of points and signals and will have all-electric interlocking.

Ryde Pier.—An additional platform has been provided and the existing platforms reconstructed in reinforced concrete.

Ashford.—Until recently, the engine shed at this point adjoined the Ashford works and had accommodation for fifteen engines. A new depôt has now been erected in the fork between the Dover main line and the Margate branch. It is in reinforced concrete throughout, has ten pit roads and holds thirty-five locomotives.

Hastings.—The very fine and suitable station at Hastings was completed. The two new island platforms were already in use a year ago, and the main entrance and station buildings were officially opened in July.

Headcorn.—Another work that was mentioned in our last Annual Article was the provision of four lines of way at this station. That, too, has been completed. It necessitated a new platform on the up side and alterations to the junction with the Kent and East Sussex Railway.

The All Hallowe Branch.—This light railway, in the Isle of Grain, is 1 mile 62 chains long. It leaves the Port Victoria branch between Middle Stoke halt and Grain Crossing halt and will serve a new building estate on the Kent coast. Construction was begun during the year.

Dover.—The reconstruction of Dover Priory station was completed, and a coaling plant is being erected on the eastern arm of Dover Harbour for loading coal into ships. It will be capable of handling 500 tons per hour.

Metropolitan.

Stanmore Branch.—The construction of this new line, 4 miles 4 chains in length, which will run from Wembley Park to Stanmore, was started during the year. It is hoped to open it next autumn.

Wembley and Harrow Widening.—This widening of 2 miles 47 chains, described herein a year ago, was opened on January 10th this year.

London Underground.

Cockfosters Extension.—Very rapid progress is being made with this work—officially known as the South-

gate Extension—which has a length of 7 miles 54 chains, and it is hoped to open the southern section, *i.e.*, from Finsbury Park to Arnos Green, in May, and the remainder in October.

Western Extension.—What is known as the Western Extension of the Metropolitan District Railway carries the Piccadilly line from Hammersmith for 7 miles 28 chains to a junction with the Hounslow branch at Northfields. This work, too, made excellent progress and the extension as far as Acton Town will probably be ready for service in June.

Physical and Optical Societies' Exhibition.

No. III. (*conclusion*).*

A WATTMETER shown by the B.T.H. Company has been designed by the company's research engineers for the measurement of the energy loss occurring in the arc of a mercury arc rectifier. The instrument is sensitive enough to register accurately at 30 volts, but will withstand the application of 7000 volts. During the half-cycle when energy is flowing, the pressure drop across the arc reaches approximately the former value, while on the reverse half-cycle the voltage may rise as high as 7000. The sensitivity of the wattmeter is obtained by the use of a hot cathode mercury vapour rectifier across the meter potential coil which shunts the excessive current away from the coil during the reverse half-cycle. As the arc current has both A.C. and D.C. components, the instrument current coil cannot be connected to the arc circuit by a current transformer, while the inductance of the coil prevents the use of a simple shunt, but the difficulty is overcome by the use of a shunt and current transformer in series.

Another interesting B.T.H. exhibit was a corona-detecting apparatus, intended for the detection of corona or other electric discharges within an enclosed space, such as a transformer tank. It consists of a special microphone and amplifier, both tuned to respond only to frequencies above 3000 cycles, which are characteristic of the noise from discharges, most extraneous noises being of lower frequency. The specially designed microphone is of similar type to the B.T.H. Company's pick-up, but with mechanical modifications to obtain the desired frequency characteristics. Several types of hot cathodes for gas-filled discharge tubes were shown, including a sectional model of the indirectly heated, heat-shielded vane type. As hot cathode gas-filled discharge tubes operate without electronic space charge, they need not be fitted with thermionic cathodes of the filamentary type common to high vacuum valves. Cathodes in which the electron emitting surfaces shield each other, or in which separate heat shields are employed, can be used, the efficiency of such cathodes, expressed in ampères of emission per watt of heating power, being very high.

Among the hot cathode gas-filled devices were the hot cathode mercury vapour rectifier, the thyratron and luminous discharge tubes. The first is claimed to have many advantages over the high-vacuum thermionic rectifier. Owing to the reduction of space charge by ionisation, the internal voltage drop is low and constant, thus resulting in high efficiency and good regulation. The thyratron which has many industrial and scientific uses, is a hot cathode rectifier fitted with a control electrode or grid, and has the properties of a relay or an arc with a variable starting voltage. The use of hot cathodes in gas-filled discharge tubes enables low voltage heavy-current tubes of high luminosity to be designed, and one of the models which was shown at the Exhibition is intended to serve a beacon light. Tubes similar to this have been constructed up to several kilowatts capacity, corresponding to several thousand candle-power. Experiments were carried out to demonstrate the fundamental properties of the thyratron. In the first instance a thyratron was arranged in a D.C. circuit, and a means provided for varying both the anode and grid potential. In this way the control ratio curve of the thyratron can be taken and an important characteristic is demonstrated—*i.e.*, control by means of grid voltage of the starting of the arc, but no control by the grid after the arc has been established. In the case of another experiment, a thyratron was arranged in an A.C. circuit, in such a manner as to supply the grid with either direct current and/or alternating current.

With an alternating potential on the anode, the grid can regain control each time the anode potential falls to zero. The effects of applying grid voltage at a less negative potential than the critical voltage is to allow the arc to flow, but the arc can be stopped by applying a grid voltage more negative than the critical voltage.

In an experiment carried out to demonstrate the fundamental properties of the thyratron, the latter was arranged in an A.C. circuit, so that the phase of the grid voltage could be advanced with respect to the anode voltage. The magnitude and sign of the grid volts applied were such that when 180 deg. out-of-phase no anode current flowed. In another demonstration, a capacity bridge normally maintained the voltage of the grid 180 deg. out-of-phase with the anode voltage. The circuit was such that the capacity change due to the approach of a body to a condenser arranged in a pillar A, Fig. 22, caused the grid to become positive when the anode was positive, and hence allowed current to pass. This current closed a 20-ampère contactor operating a floodlight, and the experiment illustrated the smallness of the power required to control the grid voltage of a thyratron in order to release currents of large magnitude. By merely placing the hand on the pillar A, the spot

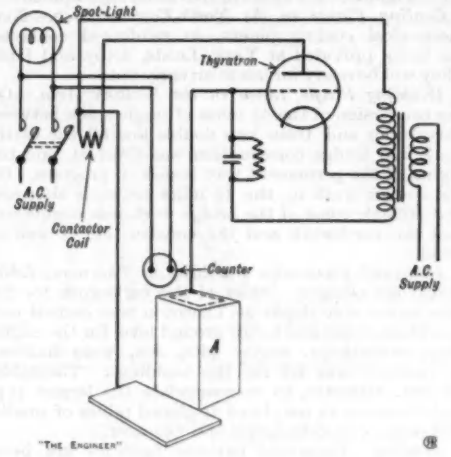


FIG. 22—THYRATRON CONTROLLING SPOT LIGHT—B.T.H.

was energised by the contactor and the number of times the apparatus was operated indicated on the counter.

A low-power high-frequency heater for induction heating work on small valves or photo-electric cells was arranged, as shown in Fig. 23, the oscillating valves being of the Mazda T.V. 845 type. Owing to the construction of the heater coil shown above the photo-cell, which provides a highly concentrated field, a

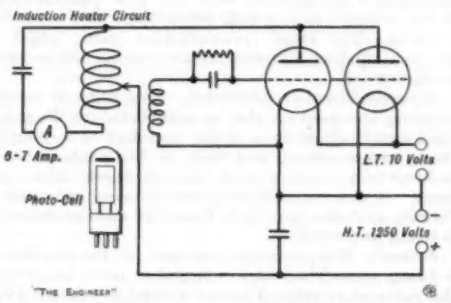


FIG. 23—INDUCTION HEATER CIRCUIT—B.T.H.

power of only 130 watts is required. The normal operating frequency is 1600 kc. The method of controlling a motor by means of a thyratron with a photo-cell in the grid circuit is shown in Fig. 24, which is self-explanatory. An exhibit of considerable interest was a neon mercury "change-over" tube. A hot cathode discharge tube contains neon and a globule of mercury, and by varying the temperature of the coolest portion of the tube, the ratio of the pres-

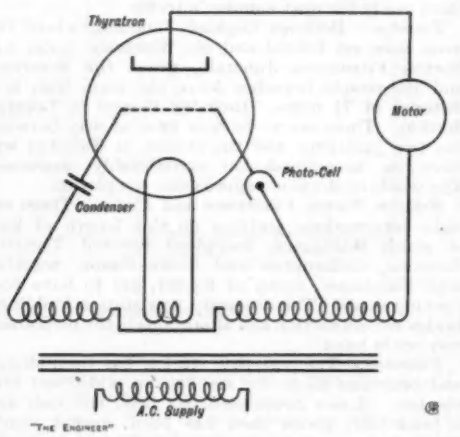


FIG. 24—MOTOR CONTROLLED BY PHOTO-CELL AND THYRATRON—B.T.H.

sures of neon gas and mercury vapour can be altered. In this way the tube can be caused to operate either as a neon or as a mercury discharge tube. As the mercury pressure is varied, the glow changes progressively, but retains a sharply defined boundary between the two colours.

Owing to the novel principles of its inductances and variable condenser, a sub-standard wavemeter which was exhibited by H. W. Sullivan, of Leo-street, Peckham, S.E. 15, is claimed to be exceptionally accurate, the total instability due to all causes, including considerable changes of temperature and humidity being less than one part in 20,000. It consists of a simple resonant circuit, in which continuous oscillations are generated by an associated negative resistance device, *i.e.*, a four-electrode screened grid thermionic valve, which obviates the necessity for a troublesome reaction coil. The valve shunt to the resonant circuit is of such a high impedance that variations of the potential of its various electrodes are negligible in their effect upon the oscillation frequency of the wavemeter, and the elimination of the reaction coil naturally gives rise to a much greater calibration stability than would otherwise be possible. The wavemeter has been designed to give the highest accuracy it is possible to obtain in a simple wavemeter of considerable range, in which the calibration depends upon values of capacity and inductance. For higher accuracies it becomes necessary to employ the more complicated standard harmonic wavemeters, in which the frequencies are governed by the vibrations of either an Elinvar tuning fork or a piezo-electric quartz crystal. The instrument under consideration has the advantage of great simplicity of working, and does not call for skilled operators. Hence it is particularly suitable for use in remote countries.

As a sub-standard the instrument is a useful addition to a harmonic wavemeter. The theoretical circuit is shown in Fig. 25, where C_1 is the main

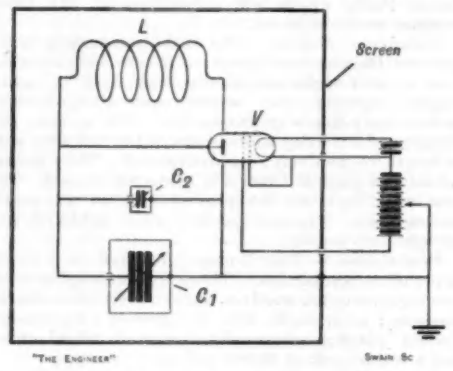


FIG. 25—SUB-STANDARD WAVEMETER—SULLIVAN

series gap variable condenser, and L one of the range coils, which completes the resonant circuit. A screened grid four-electrode valve V is connected to the circuit, as shown, and is included in the main earthed screen of the instrument. It will be perceived that the resonant circuit is merely shunted by the conductance and capacity between the anode and screen grid of the valve, and in order that any instability of the inter-electrode capacity may be negligible, valves are used which have small inter-electrode capacity and a rigid electrode system. In the screening chamber a control panel is fitted to permit of the simple adjustment of the various potentials to the values given on the calibration certificate. The special inductances and the variable condenser used are covered by patents Nos. 326,190 and 297,787 respectively. The range of the instrument shown is 150 m. to 10,000 m.

A wide range of 2½in. instruments, all fitted in uniform cases of moulded insulating material and

FIG. 26—MULTI-RANGE D.C. TEST SET—FERRANTI

including single-range thermo and electrostatic instruments, single and multi-range moving coil, and moving iron and rectifier instruments, was shown on the stand of Ferranti, Ltd., of Hollinwood, Lancs. In order to demonstrate the robustness of the instruments visitors were invited to apply 25 volts to a 2·5-volt instrument. The instruments have a long scale and good damping properties and they all comply with the appropriate British standard specification for first-grade instruments. The 2½in. moving coil instruments are applied to a range of cell testers,

* No. II. appeared January 15th.

including side and centre zero open circuit testers and a loaded cell tester, which adds a load of 300 ampères at 1·6 volts to a heavy discharge cell as used for starting purposes on motor vehicles. There was also a multi-range D.C. test set, as shown in Fig. 26, embodying a 2½in. moving coil ammeter and voltmeter with self-contained ranges from 1 milliampère to 25 ampères and from 75 millvolts to 250 or 500 volts. Direct reading resistance testers mounted in bench type stands and a tester for carrying out tests on radio valves under working conditions are also provided with the 2½in. moving coil instrument. By the addition of a small transformer, which can be clipped round an A.C. conductor the 2½in. moving coil ammeter is used as a clip-on instrument for measuring the current in the conductor without breaking the circuit. Besides the 2½in. instruments, 3½in., 4in., 6in., and 8in. moving iron and moving coil switchboard instruments with open and protected dials were shown, together with a range of 3½in. and 6in. portable instruments for A.C. and D.C. circuits. There was also a small-phase rotation indicator and a precision type current transformer accompanied by a photographic reproduction of a National Physical Laboratory test certificate on such a transformer, showing no ratio error and only one minute phase angle error from 5 per cent. to 125 per cent. of full-load current on both 5 and 15 VA loadings. For the first time the firm was exhibiting a selection of its hand start mains driven synchronous motor clocks embodying a patented design of motor which does not make use of a permanent magnet. The motor has the unusually low speed of 166 r.p.m.; all the internal steel parts are cadmium plated and the motor is fitted with long self-aligning bearings with oil reservoirs. The standard model is designed for 200/250-volt supplies. A self-starting slow-speed clock which has been in use for the last two years for maximum demand indicator operation was also shown, and it is claimed to be the first British-made clock of its kind. The electrostatic voltmeter shown in Fig 27 was

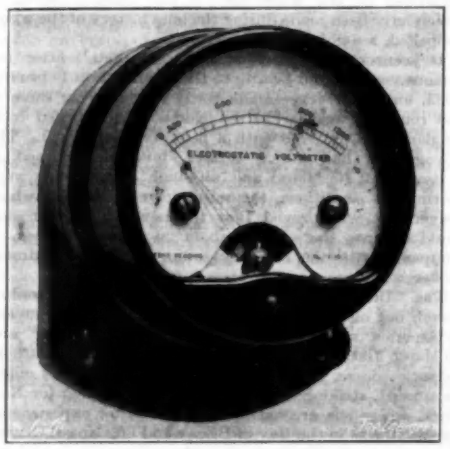


FIG. 27—ELECTROSTATIC VOLTMETER—FERRANTI

another Ferranti exhibit. Whilst this type of instrument does not usually displace a moving coil instrument for D.C. or a moving iron instrument for A.C., there are many purposes, mainly in the laboratory, for which an electrostatic voltmeter is the only permissible type on account of its absence of current consumption. Occasionally it displaces high-range moving coil and moving iron instruments, as it can be made self-contained up to 2500 volts, whereas the other types require several resistance boxes for such ranges. The lowest range is 450 volts and is subdivided from 100 volts with a very good scale shape. The design of the fixed and moving system is the subject of a patent application. Protective resistances are included within the case in order to reduce danger due to burn-out on over-voltage. Fuses are quite useless, as the damage is done before the fuse has blown. Similarly, spark gaps generally cause the instrument to burn out on flash-over.

A self-contained "Metalix" X-ray apparatus for crystal analysis was shown by Philips, Ltd., of Philips House, 145, Charing Cross-road, W.C. 2. The apparatus is illustrated complete in Fig. 28, whilst Fig. 29 shows the main details. A is the transformer, B the cooling fan, and C a special tube with a copper anode and two nickel apertures. An alternative tube with a molybdenum anode, two thin glass apertures and two zirconium fillers is also provided. Two Debye-Scherrer cameras are mounted on the apparatus, as shown at A in Fig. 28, each having two diaphragms and three specimen clamps. A switch with plugs and cables and a three-pole wall socket are supplied. The apparatus can be directly connected to 220-volt A.C. mains, the consumption being about 450 watts. The transformer casing has a water-cooled jacket, which, under normal operating conditions, only need be filled with water; but if the apparatus is used for a period exceeding two hours, water must flow through the jacket continuously. The two X-ray tubes mentioned are interchangeable, and a tube can be removed by unscrewing the two milled nuts D and E, when two plungers, F and G, are exposed. One of them automatically adjusts the voltage and current to suit the tube to be used, whilst the other interrupts the primary

FIG. 28—"METALIX" X-RAY APPARATUS—PHILIPS

circuit of the transformer when the tube is removed. Each tube is encased in an earthed metallic covering. The cameras supplied can be used for both the

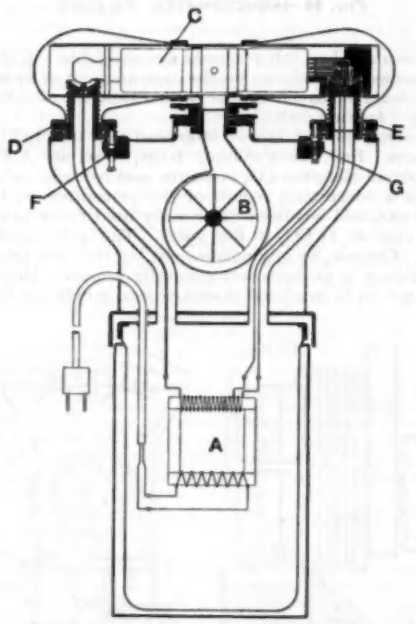


FIG. 29—DETAILS OF X-RAY APPARATUS—PHILIPS

Debye-Scherrer and Seemann-Bohlin methods. Two types of radiographs can be taken: (1) With the film on the exterior surface of the camera, and (2) with the film pressed in contact with the interior of the camera by means of springs. Precision work is always carried out with the film in the external position, the film being secured against the surface of the camera by means of clamping plates and screws. Provision is made for focussing by means of a fluorescent screen with cross wires. Once the apparatus has been earthed by the mid-point contact of the three-pole wall socket, all external parts can be handled with perfect safety. The exposure times are said to be considerably less than those of the older types of apparatus, and there is no need for continuous observation. The apparatus provides complete protection to the operator.

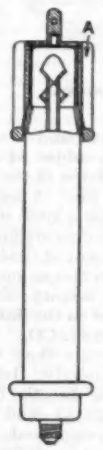


FIG. 30

The Philips EHT "Metalix" rectifying valves, which are claimed to represent a great advance on EHT glass bulb valves, were also shown. In these "Metalix" valves the cylindrical chromium discharge chamber A—Fig. 30—forms the actual anode, and a negative charge which would cause the flow of electrons from the filament to the anode to be impeded cannot be formed. A glass insulating cylinder directly sealed to the cup-shaped chromium-iron anode, supports a hot wire cathode of generous proportions. As the anode has a number of radiating fins which are exposed to the air, efficient cooling is secured. The "Metalix" valve can therefore be used on very high ratings. The "space charge" effect is said to be greatly reduced, and the drop of potential across the valve is small. Two types of these valves were shown, one for 125 kV and the other for 160 kV maximum reverse pressure. When required for industrial purposes, the first type can be supplied with a water cooling device.

Nalder Brothers and Thompson, Ltd., of Lane Works, 97A, Dalston-lane, were exhibiting examples of their over-current inverse time limit relays, reverse current relays, and directional over-current relays, the latter being recommended for the protection of ring mains and interconnected networks. The fixed system of these relays consists of an external U-shaped electro-magnet, carrying the main windings, and an internal core of cruciform shape, and on one of the polar projections there is an auxiliary coil which is energised inductively from the main windings. The moving system consists of a light aluminium cylinder which is free to rotate between the poles of the external and internal electro-magnets. The current settings of the standard relay are from 50 to 200 per cent. of the full load, and the definite minimum time settings are adjustable between 0·2 and 2 seconds. The relays are supplied either as single, double, or triple-pole units, and in the form of horizontal or

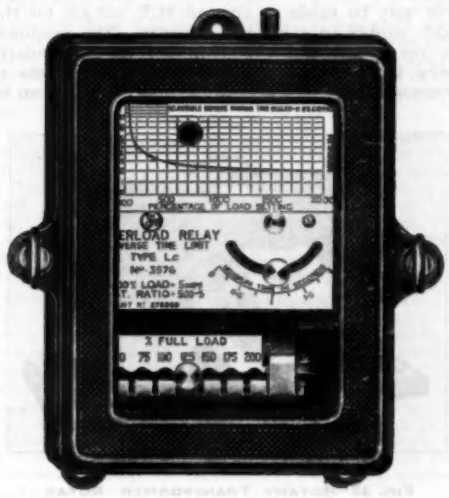


FIG. 31—OVER-CURRENT RELAY—NALDER

vertical units. The illustration—Fig. 31—shows a single-pole "L type," over-current, inverse relay, with an adjustable definite minimum time limit.

Hardness testing instruments, "Mikrotast" gauges, spring-testing machines, a pocket radiation pyrometer, collapsible taps and die heads, and tachometers and speed counters were shown among other things by Coats Machine Tool Company, Ltd., of 14, Palmer-street, London, S.W. 1. The firm's new spring-

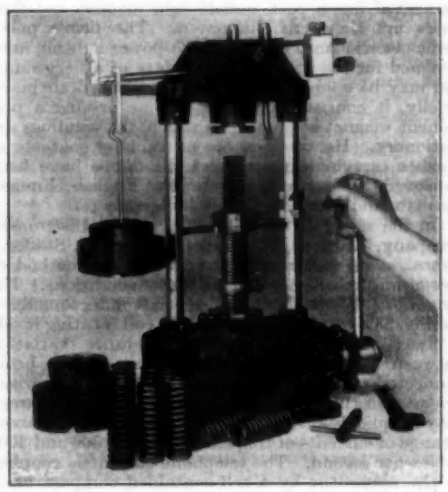


FIG. 32—SPRING TESTING MACHINE—COATS

testing machines, to which, owing to limitations of space, we must confine our attention, enable a large number of springs to be rapidly examined by an unskilled operator, and may be used for compression and tension tests. The knife-edge weighing mechanism is, as usual, situated in the upper housing, and has a ratio of 1 : 10, the main improvements embodied in the latest weight-operated machines being the reduction in the knife-edges employed. The load is determined by placing loose weights on the beam, when

variations in length are read in $^1/_{32}$in. on a scale attached to the right-hand pillar in such a way that the actual length of the spring in either its open, compressed or elongated state is indicated, this being a distinct advantage over the firm's original type of machines, which indicated the number of inches the spring had been compressed or stretched. Adjustable stops for limiting the compression and tension stroke are provided for testing quantities of springs, and in addition there are movable tolerance markers, both on the balance and vertical length scale. The drive in the case of the machine shown in Fig. 32 is through a hand lever, rack and pinion; in the case of another machine, designated R 25, with a load limit of 56 lb., the drive is through a screw and hand wheel—a drive which is said to permit of very accurate length adjustment when small and highly sensitive springs are being tested. In both cases the machine is first balanced by means of the sliding weight shown on the right at the top of the machine. Weights are then placed on the weight beams and the balance is re-established by turning the hand wheel or by pulling forward or pushing back the hand lever in the case of the machine illustrated. The re-establishment of balance is indicated by the pointer in the upper left-hand corner directly over the weight holder. When the machine is used for tension-testing, the spring is gripped by hooks, one of which is to be seen at the top of the machine.

Rotax, Ltd., of Willesden Junction, N.W. 10, were exhibiting machines for radio purposes and pneumatic-electric lamps for use in fiery mines. Models of anode converters, as shown at other exhibitions, were in evidence. These machines operate from a D.C. source of any voltage, and even a 6-volt accumulator may be made to give an H.T. output for the anode supply to a wireless receiver. The machines are very light and compact, and are particularly useful to those who use wireless receiving sets in places where there is no public supply. They can be

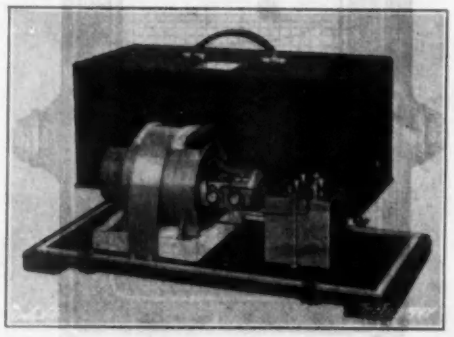


FIG. 33—ROTARY TRANSFORMER—ROTAX

operated on country-house installations working at 32, 50 or 100 volts D.C. Rotary transformers for converting D.C. to A.C. and for the operation of A.C. all-electric receivers were shown, an interesting example being a new transformer with an anti-interference unit and soundproof cover, as shown in Fig. 33. For public address purposes, a D.C. to D.C. rotary transformer designed to run from a 12-volt accumulator, and to give 150 m.a. at 400 volts was exhibited. All these machines are said to be highly efficient, and every model with the exception of that illustrated has a cast cobalt field magnet and field losses are therefore eliminated. The firm's pneumatic electric lamp is a very high-power lighting unit, designed for use at the working face of a fiery mine, and may be operated from any compressed air main. Briefly, it consists of an air turbine driving a permanent magnet alternator in which the windings are stationary. Hence there are no rubbing contacts or brushes carrying current, and the lamps have been approved for use in mines by the English, French, German, and American Mines Departments.

On the stand of the Salford Electrical Instrument Company, Ltd., of Pell Works, Silk-street, Stafford, Lancs., a demonstration was given of a method of measuring inductances under works conditions. The apparatus consisted of a special inductometer—see Fig. 34—composed of a moving coil rotating inside a fixed coil and giving an inductance variation between 5 and 50 mH, the inductometer being connected to ratio arms to form a direct comparison bridge. In this way measurements of good accuracy may be quickly made by unskilled operatives between a range of currents of frequency between 300 and 3000 cycles per second. The telephone current is supplied to the apparatus by a self-contained compact oscillator containing three-stage filters, so that the current may be truly sinusoidal, whatever the frequency. For special frequencies the oscillator may be calibrated by means of a frequency bridge. For inductances of greater value than 50 mH, fixed inductance units wound with stranded wire on wodden bobbins, and specially impregnated to overcome variations in climatic conditions, were utilised in the demonstration. In the construction of the inductometer and fixed inductance standards, care is taken to exclude all unnecessary metal, so that eddy current losses are reduced to a minimum, and where screws are used they are placed as far as possible outside the field of the coils. In order to balance the resistance components of the circuit, it is necessary to incorporate a non-inductive resistance box in the bridge circuit, and in this way the effective resistance of inductance coils may be obtained. For accurate measurements correction is made for the variation in resistance of the copper with temperature. The frequency bridge mentioned is also specially designed to be portable and direct reading, and is suitable for use by unskilled testers. The variable units are non-inductive resistances, and the circuit incorporates two fixed condensers. The range of the model frequency bridge that was exhibited is approximately 300–3000 cycles

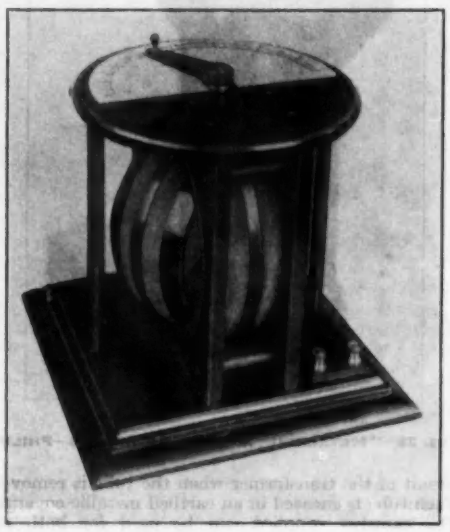


FIG. 34—INDUCTOMETER—SALFORD

per second, but other ranges are available. Instruments were also shown for the measurement of current and voltage, &c., together with examples of "Gecalloy" loading coils.

Among the exhibits of Muirhead and Co., Ltd., of Elmers End, Beckenham, Kent, was an A.E.G. Muirhead-Ranarex CO_2 indicator and recorder, which gives a continuous record of the percentage of CO_2 in a gas, and has been extensively used for recording the amount of CO_2 in flue gases. The instrument is not, of course, by any means new, but the principle of operation is perhaps not generally known. Briefly, the gas to be analysed is sucked into a cylinder by a

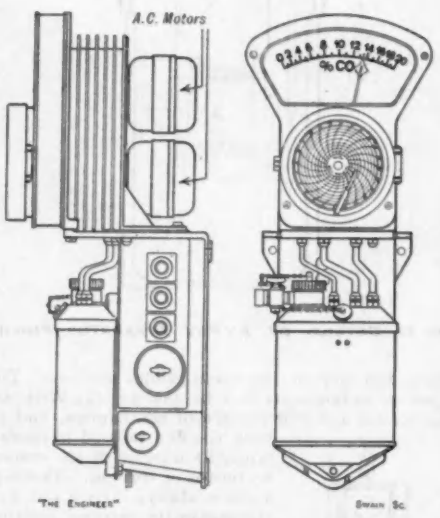


FIG. 35—CO_2 RECORDER—MUIRHEAD

fan which sets it in turbulent rotation, and a vane wheel situated in the same cylinder is subjected to a torque which for a given speed of rotation of the fan is proportional to the density of the gas. A second fan in a similar cylinder also containing a vane sucks in air. The vane wheels of the two cylinders are linked together, so that the angular displacement of the linkage is proportional to the difference in torque on the two vanes—*i.e.*, to the difference in density of the gaseous mixture and the air. A pointer on the linkage moves over a scale graduated in per cent. CO_2. The instrument may be used for gases other than CO_2, or may be arranged to read density directly. In the latest A.C. pattern each fan is driven directly by a three-phase motor—as shown in Fig. 35—and the belt jockey pulley, &c., originally employed, are dispensed with, each propeller being mounted directly on its motor spindle.

The Igranic Electric Company, Ltd., of Elstow-road, Bedford, was exhibiting apparatus for the automatic starting, stopping and speed regulation of D.C. and A.C. electric motors under the control of master devices actuated by various arrangements, such as thermostats, timing devices, push button switches, and mechanically tripped switches. Perhaps the most original exhibit on this firm's stand was an inductive time limit control panel, which we hope to describe in a later issue. It employs the time limit method of acceleration, and always causes the motor correctly to handle the loads imposed upon it. One of the principal exhibits of George Kent, Ltd., of Biscot-road Works, Luton, was a new form of combustion efficiency meter, which closely controls the air supplied to furnaces. Wild-Barfield Electric Furnaces, Ltd., of Elecfurn Works, North-road, Holloway, N. 7, were showing a patented forced draught furnace suitable for all heat treatments up to 700 deg. Cent., and intended mainly for use where absolute uniformity and close control of temperature are desired. A new type of high-temperature electric furnace for ceramics was exhibited by Mr. R. M. Catterson-Smith, of Adams Bridge Works, Exhibition Grounds, Wembley, Middlesex. In this furnace a new alloy is used for the resistors, and is said to be of great importance to users of furnaces designed for temperatures of above 1000 deg. Cent.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ROTOR SHIPS.

SIR,—A few weeks ago, Captain M. T. Tudsbery was inquiring concerning the progress of the world-famous "Rotor Ship," and as no one seems to have replied, may I be permitted to make a few remarks?

I feel sure that most people will agree that the work of Dr. Flettner, as was shown by the practical development of his novel and very scientific system of ship propulsion, presented to the world one of the greatest advances which have been made during the long history of the wind-propelled, sea-going vessel.

It seems that the rotor ship "Buckau," after her famous voyage from Danzig to Grangemouth in February, 1925, and after very satisfactorily encountering some of the roughest weather in the North Sea, returned from England to Cuxhaven with a heavy cargo of coal. The voyage out had taken 4 days, but she returned in 3 days and 20 hours, and although experiencing very stormy sea conditions, the rotors gave no trouble whatsoever. It was proved that the new wind-power ship could sail into the wind at about 20 deg. to 30 deg., as compared with the ordinary sailing ship's approximate 50 deg.

The "Buckau" was just a converted three-mast sailing vessel, but on her return she was fitted out for a voyage to America, and was renamed the "Baden Baden," and on March 31st, 1926, set sail for New York *viâ* the Southern Atlantic course, in order that the wind conditions might be studied, striking a north-western course then for New York, where she arrived safely, again after experiencing terrific storms in the Bay of Biscay and off Cape Hatteras, proving very conclusively that the rotor ship is at least seaworthy.

In reference to further developments, I believe that there has been another rotor ship, named the "Barbara," built, fitted with three rotors—the "Buckau" had two—of 3000 tons cargo capacity, about 300ft. long and 43ft. beam, with a depth of 27ft. This very interesting vessel has, I believe, made several long voyages, and has very roomy deck space, being fitted with a number of state-rooms for carrying a few passengers.

Each rotor is driven by means of a 35 horse-power electric motor, and I think that the rotors run at 150 r.p.m. as a maximum. They are, of course, controlled from the bridge, where their speed and direction of rotation is handled. To make her absolutely independent of the wind, however, two Diesel oil engines have been fitted, with hydraulic power transmission, the vessel, however, only having one screw propeller. This arrangement makes it very easy for control, as when there is sufficient wind the engines can be closed down or, perhaps, only one engine used to maintain the average speed. The total power of the two engines is, I understand, 1060 horse-power; but when driven by the rotors only, the speed can be about 10 or 10½ knots, with, of course, suitable wind velocity, very easily obtained by the trade winds.

WILLIAM P. DURTNALL.

London, S.E. 5, January 19th.

ENGINES OF FRENCH LINERS.

SIR,—I read in your January 15th, 1932, number, page 75, column first, in the lecture by Mr. Sterry B. Freeman, that the electric transmission has been rejected for our new big liner.

Mr. Freeman is mistaken, and I believe he had in mind the "Champlain," which will be propelled by geared turbines, but our 73,000 tons super-liner being built now in Saint-Nazaire will have electric drive. The propelling machinery is being built in Belfort at the factory of the French Society ALSTHOM. P. DE MALGLAIVE.

Compagnie Générale Transatlantique, Paris,
January 18th.

Railway and Road Matters.

THE whinstone quarry at Craster, on the Northumberland coast, is to be developed on an extensive scale for the export of roadmaking material.

A BRIDGE with a span of 173·16 m. is to be built over the river Riachuelo, in the Argentine. It will have an opening span of 42·5 m. and a width of 24 m.

IT is announced by the L.M.S. Railway that "lock-up" garages are to be erected at certain suburban stations in the London area. The garages, which as a start are being built experimentally, will be in blocks of five, and are to be located at Mill Hill, Harrow, St. Albans, and Watford stations. They are intended for the use of the travelling public, but in the case of large demands being made, preference will be given to season ticket holders.

RAILWAY companies are now threatened with a new form of competition. It is announced that the first of a series of air services designed to link up the coastal resorts with London will be opened as soon as certain formalities have been completed. Yarmouth has been chosen for the inauguration of the scheme, and the question of a suitable aerodrome is now under consideration by the Town Council. It is intended that Clacton shall be the next resort to have such a service.

RUMOURS have recently been prevalent that, owing to a reduction in the volume of travel, some of the cross-Channel services were to be taken off, particularly the Folkestone–Boulogne. The Paris correspondent of *The Times*, cabling on January 15th, said, however, that officials of the State and Nord Railways stated that day that no definite steps had yet been taken with regard to the further reduction of cross-Channel services and the corresponding train services in France. The only serious reduction made so far is in the steamer services between Le Havre and Southampton, which since January 1st have run only three times a week—on Tuesday, Thursday, and Saturday—instead of every week-day, as formerly.

ONE hears very little in these recent years of the Mansion House Association on Railway and Canal Traffic. At one time it led a very active life and was a veritable thorn in the flesh to railway companies. There is less need now for its services, and it has even changed its name, and recently, as the Mansion House Association on Transport, has been expressing its opinion on the report of the Royal Commission on Transport. This has been done in a report to the Minister of Transport, but perusal of a summary of that document does not seem to produce argument for any new departure, but it is some satisfaction to know that the Association welcomes the expression of the opinion of the Royal Commission that there should be co-ordination of transport, but that it affirms its opposition to any form of nationalisation, and, further, to the formation of any public trust, except in particular cases of docks and warehouses.

GIVEN a good-running, oil-lubricated vehicle, and vacuum brake equipment on the train, there is no difficulty and no danger in running freight trains at high speeds, and thus ensuring early and prompt delivery of consignments, and so successfully competing with firms sending goods by their own road transport. We make this observation as a consequence of the intimation that the London, Midland and Scottish is accelerating its freight services—*e.g.*, between London and Leicester and Nottingham. Justification for the proviso with which we open this paragraph is to be found in the reports on two accidents to high-speed goods trains in 1906—one at Kirtlebridge, Cal., on April 6th, and another at East Fortune, N.B., on November 1st. In the former report Sir Arthur Yorke observed: "If goods trains are to travel at the same high speeds as our fastest passenger trains—this train was running at 60 m.p.h.—the equipment of the former, especially the wheels, axles and springs, must be brought up to and maintained at the same high standard as is adopted with the latter. It is also desirable, in the case of such goods trains, that they should be equipped with a quick-acting continuous brake."

ONE of the means whereby large economies in the number of signal-boxes are being effected—economies that are saving the companies half a million a year in signalmen's wages—is the long-distance operation of points. Therein a low-voltage motor mechanism at the points is controlled from a signal-box which may be a mile or so away—there is a case in Ireland where the distance is over 3 miles. Such an economy was being put into operation on Sunday, September 27th last at Welwyn on the London and North-Eastern at the junction whereby the two lines over Welwyn Viaduct become, at its south end, four lines. That would allow the junction to be worked from Welwyn North box, 923 yards away, and Digswell Junction signal-box to be dispensed with. During the transition period the facing points were temporarily out of use and fastened by a slip. When it was necessary, for testing purposes, to try its lever, the points were unclipped and afterwards again clipped by a man on the ground, stationed there for that purpose. The job took longer than was expected, but at 3.30 p.m. on Tuesday, the 29th, the points were completed, and all that remained to be done was some electrical interlocking on the levers actuated by track circuits at the points. The latter is an important feature in long-distance operation, as they prevent the signalman, who cannot, of course, see the points, moving them when they are fouled. To assist him in that respect the track circuits are indicated by an illuminated diagram. At the hour named the traffic inspector, who had been on duty at the points, went to the signal-box, and at 6 p.m. the groundman was relieved. Soon after that time the new groundman was asked over the telephone to unclip the points, and did so, but was not told afterwards to reclip them. At 6.40 a special passenger train passed, and, simultaneously, it was found necessary to move the points again. The signalman asked the traffic inspector for permission to do so, and that man, looking at the diagram, read it to indicate that the special had passed, so he gave permission for the movement, which consequently occurred as the train was on the points, and part of it was derailed. There were no serious consequences, and Colonel Trench's consequent report thereon makes no specific recommendations.

Notes and Memoranda.

Two traction engines, which were built in the early 'nineties, were recently sent back to Marshall, Sons and Co., of Gainsborough, for overhaul. One had been in constant service for thirty-eight years and the other for forty years, yet both of them had their original fire-boxes.

AN interesting comparison of the relative qualities of various home-grown timbers has been made at the Forest Products Research Laboratory, Princes Risborough, to determine their ability to resist various kinds of stresses. The rather unexpected result arrives that, among hardwoods, oak is not the strongest, and is surpassed by ash and beech in several services, although its characteristics seem to be more consistent than those of other woods. A report on the investigation may be obtained from H.M. Stationery Office, price 2s. net.

ASBESTOS, a mineral product renowned for its insulating and fire-resisting qualities, has been one of the principal mineral products of Canada for four decades. Known to the ancients for centuries, the first discoveries of importance in America were made near Thetford, Quebec, in 1862. An abundant supply stimulated search for new and varied uses, and as the demand for fibres for industrial uses grew the mining industry expanded until at the beginning of this century it had become one of the most important industries.

SOME rather interesting deductions can be made from a survey of the official reports on boiler explosions during the past year. In all nineteen explosions of boilers proper were investigated. Of these, two were caused by the accumulation of scale, and so can be classed as sheer carelessness. Taking the remaining seventeen, the average age at which a mishap may occur is twenty years. It would also appear that marine boilers are the most long-lived, only two having met with accidents under the age of twenty and most of them not before twenty-five to thirty years. The water-tube boilers were considerably below the average.

Two Frenchmen, Monsieurs Thomas and Conland, are reported to have devised apparatus by which ordinary print can be read by the blind. The apparatus is called the "photoelectrograph." A ray of light is made to pass over the printed page, and as each letter is illuminated the corresponding letter is presented in relief and in magnified form in another part of the machine, where the blind reader identifies it by touch. Not only ordinary print, but Braille also, says *The Times*, can be read with the machine; in the latter case it has the advantage that the Braille characters can be printed with ink on a smooth page, and need be no larger than ordinary type, thus reducing Braille types to a convenient size and making them cheaper and easier to produce than hitherto.

ONE of the members of the Technical College of Osaka has, according to the *Far Eastern Review*, devised a method of producing petrol, or, in fact, two methods. A mixture of a quantity of crude petroleum with 10 per cent. of catalytic charcoal and 2 per cent. of other products of a chromic basis, is allowed to stand for chemical reaction for twenty-four hours. The clear quantities are then separated and neutralised by alkaline soda and washed with water, afterwards dehydrated by calcium chloride. To the result 25 per cent. of alcohol is added with 1 per cent. of acetone. This treatment results in a petrol of about 90 per cent. of the crude that has been treated, and in quality is equal to the petrol spirit obtained by "cracking." The second method starts from alcohol, of which large quantities can be had from the sugar refineries, to which refined petroleum—kerosene presumably—is added with "carbon actif." But full details of this method are not yet disclosed, although said to have been fully worked out at Tokio, and the patent bought by Mitsui and Co.

IN the course of a lecture on "Lighthouses," given before the Royal Society of Arts, Mr. D. A. Stevenson explained that on a ship a wireless bearing is observed relatively to the ship's head. Hence its correctness is limited to the accuracy with which the ship's compass indicates the instantaneous direction of the ship's head. In a calm sea it is possible to keep the ship's head steady to within 1 deg. or 2 deg. and in a rough sea the swing may be 5 deg. or more. There is a lag between the readings of compass and ship's head, and unless a magnetic compass is calibrated frequently its accuracy is doubtful to within 2 deg. over the whole scale. In ships that are much susceptible to the motion of the sea accurate direction finding is not to be expected. In many cases it is not unreasonable to assume bearings obtained as being accurate to within 2½ deg. which gives an angle of 5 deg. Where a ship is in a position to get a good cross-cut from two wireless transmitters she knows she is somewhere within a certain area and at 75 miles off with an error of 2½ deg. she does not know her position definitely within an area of 40 square miles.

THE works and salt pans of Palestine Potash, Ltd., are situated on the north-west shore of the Dead Sea, just below where the Jordan enters, and only about 6 miles distant from Jericho. The salt pans cover already many hundreds of acres. Between the shore of the Dead Sea and the mountains of Judæa is a vast plain which slopes very gradually upwards from the shore towards the mountains. Part of this plain, with its gradual gradients, is being used for salt pans, connected with one another by channels. Water from the Dead Sea is continually pumped into the pans on the highest contour line, and after filling the highest pan it flows on through these channels or sluices into the next pans lower down and the next. Sun and wind, acting on this shallow, always moving water cause rapid evaporation. When the salts reach a certain stage of concentration, the remaining water can no longer hold up the salts in solution, and they drop to the bottom of the pans. This process goes on continuously except in winter months, when the water is drained off and the precipitated salts are harvested and sent to the factory for concentration. A part of the final liquor is pumped to the bromine factory, the rest flows back to the Dead Sea. The bromine factory started operations last February, and the potash factory is now practically ready to produce muriate of potash on a commercial scale.

Miscellanea.

THE Yawata Ironworks, Japan, is increasing its capacity for producing tin-plates from 20,000 tons to 50,000 tons a year.

A REGULAR service of steamers from Halifax, Nova Scotia, to Baltic ports is being arranged by an American shipping company.

DURING last year 546,650 horse-power was added to the hydro electric plant of Canada, making the total now 6,666,000 horse-power.

SPAIN is to sell by auction four cruisers, three destroyers, one gunboat, six torpedo boats, one submarine, and a fisheries protection vessel.

A NEW water reservoir with a capacity of 19,000,000 cubic feet has been provided on the Kowloon side of the bay in the Colony of Hong Kong.

EFFORTS are being made in China to restart the Han Yeh Ping Ironworks and the Yangtze Ironworks, which have been shut down for some time.

THE Government of New South Wales proposes to make a grant of £50,000 towards the assistance of the shale oil industry, which has been started at Newnes. The oil so far produced is said to be quite satisfactory.

IT is proposed to develop the water power of the Cheakamus River in British Colombia. It is estimated that 220,000 horse-power can be produced. The scheme involves the use of a head of 3574ft. in one step.

THE Lukens Steel Company, of Coatesville, Pa., has established in the Mellon Institute, Pittsburgh, Pa., an Industrial Fellowship, whose purpose is the scientific investigation of processes employed in the manufacture of steel plates.

THE Tirupur Municipal Council, in the Madras Presidency, has decided to secure a supply of electricity from Pykara Falls for the electrification of the town at an estimated cost of Rs. 2 lakhs. The scheme, which will be carried out by the municipality itself with the help of the Government, will enable Tirupur to be electrified within a year.

THE proposal of the Minister of Public Works that the construction of the Gebel Aulia dam, on the White Nile, should be resumed was, says the *Daily Telegraph*, accepted on January 14th at a Cabinet meeting over which King Fuad presided. The approval of Parliament will be sought immediately. It is hoped that the work may be resumed this summer. The cost is estimated at £E500,000. This dam was started in 1913. Work on it has been resumed and suspended no fewer than five times.

A NEW high percentage copper lode has been discovered not far from Bolidon in North Sweden by the Geological Survey Department, prospecting with the modern magnetic and electrical methods. The Department feels confident that further deposits will be discovered by instituting surveys on a still larger scale. The main lode yields an average of 14·8 per cent. copper per ton in a continuous width of 4·63 m. Good quality ore deposits have been brought to light in several places, and it is the opinion of the Geological Survey Department that henceforth the prospecting should be carried on with even greater minuteness.

SYSTEMATIC prospecting and geological traversing was carried out by the Rhodesia Minerals Concession throughout the year 1931 to June 30th. According to the consulting engineer's report, none of the prospects on which work was done during the rainy season proved to be of value, but discoveries of occurrences of minerals of economic value were frequent. The majority of the mineral occurrences found are of no economic value, but in some instances trenching and pitting, and possibly diamond drilling, must be done to determine the extent and character of the mineralisation. The balance sheet shows that expenditure for the year, after deducting interest received, amounted to £17,417.

IN every country the problem of the control of domestic and industrial wiring and electric installation work has been a matter of anxiety and difficulty. In France the principal professional organisations relating to architects, builders, wiring contractors, power companies and apparatus and accessory makers have got together and have set up the "Bureau Electricitas." This organisation provides engineers to watch work in progress, to test it when completed and to examine it periodically. Its services are open to owners of properties, contractors, power companies, insurance companies and public bodies. The head office is at 54 Avenue, Paris, which is also that of the International Biennial High Tension Conference.

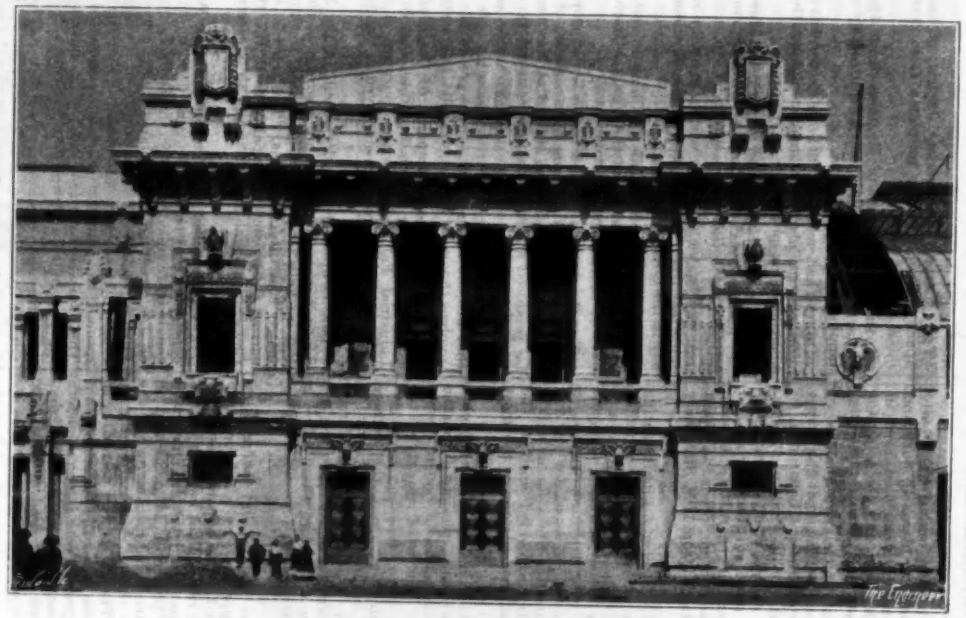
A REPORT on the position of the German coal tar products industry, referred to in the *Chemical Trade Journal and Chemical Engineer*, states that owing to the continued limitation in the operation of coke oven plants, stocks of pitch are decreasing. In the West they have now practically disappeared, so that demands for briquette making have to be met by considerable quantities from the Eastern German distillation plants, as well as from Upper Silesia. The cost of transport has been slightly reduced by the 15 per cent. concession on the carriage of pitch granted by the German railways. The average price of pitch in Germany increased from 45 marks a ton during the first half of 1931 to 60 marks per ton during the second half.

IN order to help stabilise employment in the Montreal region, work on the canal and power plant of the Beauharnois Power Corporation on the St. Lawrence River above Montreal is to be carried through the winter months without any lay-off of men. Work during the winter months will include the erection of three bridges across the canal, placing rock on the inner side of the canal banks to prevent erosion, excavation in the boulder clay section of the canal, reconditioning the construction equipment, finishing the interior of the plant and installation of hydraulic and electrical equipment to produce an initial output of 200,000 horse-power next summer. In this way the company expects to be able to keep an average of 2000 men on its pay roll during the winter. Last winter the force was reduced to about 600.

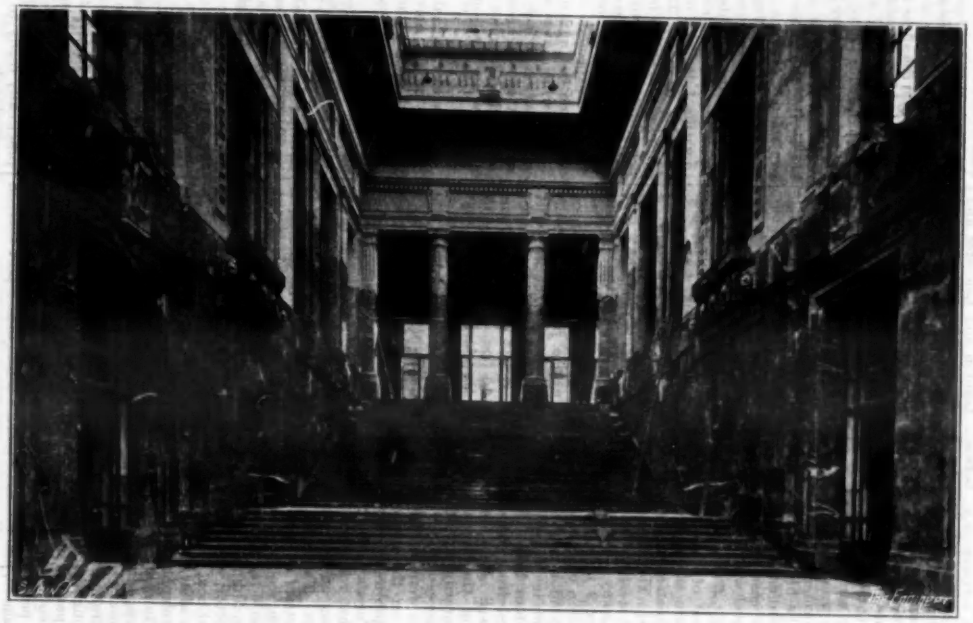
THE NEW CENTRAL RAILWAY STATION AT MILAN

(For description see page 93).

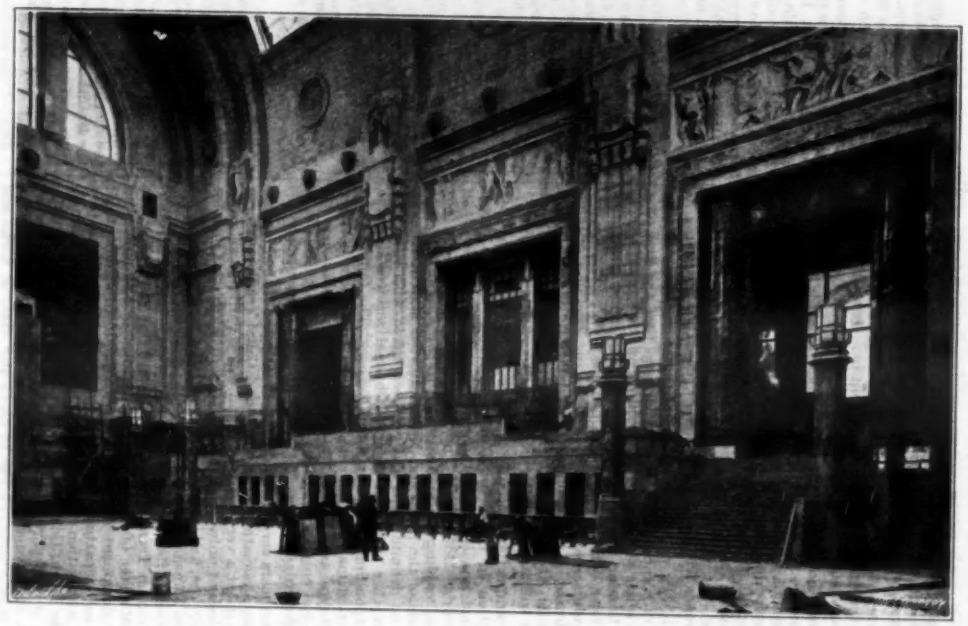
THE MAIN FACADE



THE ROYAL PAVILION



STAIRWAY FROM CARRIAGE DRIVE TO MAIN PLATFORM



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The Engineer

JANUARY 22, 1932.

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**** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

PROTECTION AND THE ENGINEERING INDUSTRIES.

SEVERAL weeks have now passed since the United Kingdom turned from Free Trade to Protection, and a certain amount of impatience is being displayed by the engineering and allied industries because decisions on which they base their hopes of revival are delayed. Protection has been given to some other trades, and we may assume that the hesitation to apply it to engineering, and particularly to iron and steel, is due to the difficulty of deciding upon a scale which will secure the maximum advantages to the country with the minimum of loss. No one can doubt that this object can only be attained by the careful scrutiny of a vast number of factors, and that time is required to formulate a scientific tariff. Yet, even after due allowance is made for the exaggeration of partisans, there is no question that rapid decisions are imperative, for the uncertainty which prevails is creating great damage to industries. It would be better for them to know that they were to enjoy no protection, or far less than they anticipated, than to remain for long in ignorance about their fate. Amongst such industries, that of iron and steel is prominent. It has suffered severely by foreign dumping, and it has been more persistent than any in its demand for Protection. We do not know what the final decision may be when the interests of the country as a whole are considered, but we suggest that if the problems were attacked by the hearty co-operation of the Board of Trade and the representatives of the industry, it should be possible to arrive quickly at a measure which would subsequently be endorsed by those responsible for a scientific tariff. Despite the bad days upon which it has fallen, the iron and steel industry remains amongst the greatest in the country, and in view of its precarious position it may justly ask for preferential treatment, if for no other reason than to remove the injurious uncertainty which now prevails.

At its recent quarterly meeting, the Grand Council of the Federation of British Industries reviewed the national position concerning Protection and the policy of industry in relation to it. It agreed that "no change had occurred in the situation which altered the views of industry as to the steps which are required to restore prosperity," and it outlined a policy for the guidance of the Government. Its conception of a national economic policy demands (*a*) a new spirit of economy in internal government—covering administration, taxation, and expenditure—with the object of restoring the competitive efficiency of the country; (*b*) a new fiscal system; and (*c*) a financial, monetary, and investment policy mainly directed towards the restoration of industry and to the development of markets for British goods. Under the first heading it comments, once more, upon the extravagant expenditure on social services and administration to which this country has been subjected for many years, and asserts, with complete justice, that heavy direct taxation at unreasonably exorbitant rates, "is peculiarly inimical to the accumulation of capital and to its investment, as well as a serious discouragement to the enterprise and initiative that are essential to the well-being of an industrial and trading community." Under the third heading it deals with financial questions, and suggests that the first steps towards reorganisation should be Imperial monetary co-operation and an investment policy aimed at Imperial development. Under the second heading, "a new fiscal system," the Grand Council summarises in a few sentences its policy with regard to tariff reform. It follows the usual line—protection of home industries, extension of Empire preference, and the breaking down of foreign tariff barriers—but, of course, no reference is made to tariffs for the increase of national revenue, for, however commonly that aspect of tariffs may be accepted by the public, it is, we believe, discountenanced by national economists. The object of a tariff is the encouragement of industry by the reduction of importation of goods which can be made in the country. If a tariff were imposed to raise revenue, a temptation to fix the rates at a point which would just not deter importation would result. Thus the State would find itself torn between two opposed courses, either to encourage home industries by preventing imports, or to encourage imports in order to secure revenue! With these principles of tariff reform we need not further concern ourselves, but it does seem desirable to say one or two words about the means which the Federation of British Industries advances for the preparation of a tariff. There is evident in many quarters, as we have already observed, impatience with the Government because so little has as yet been done. Despite the fact that a high tariff wall has not saved the protected industries of other countries from collapse, those of our industries which have suffered most from the depression believe that the immediate imposition of duties on foreign goods is required for their salvation. Thus we find Mr. L. S. Amery, writing in the *Observer* of last Sunday in support of tariffs on iron and steel, asserting that "the remedy is urgent. The industry is on the verge of collapse, and even a few weeks' delay may do irretrievable damage." Some of those who hold such despondent views favour the immediate imposition of an *ad valorem* duty on *all* imported goods. The figure of 10 per cent. has been mentioned. The F.B.I. gives adherence to this as a temporary policy, but, cognisant of its defects, combines with it "a system of graded duties and a free list." We deem it hardly probable that the Government will agree to that policy, even as an expedient, for it would almost inevitably increase the cost of manufacture in this country, and still further reduce its power of competition in overseas markets. On the importance of maintaining foreign trade, too much stress cannot be laid, but it is in some danger of being overlooked by those who are anxious to restore the home trade. Let us foster no illusions. We cannot live without foreign markets, and no form of Protection which weakens our power to sell abroad will avail us at all. International questions apart, the best argument for tariffs is that by enabling us to develop our industries they will help us to reach a position at which our power of competition will increase.

This country is in a very exceptional position, and in many industries, the iron and steel trade especially, a tariff which would help without harming can only be devised after most painstaking and careful investigation. The F.B.I. is aware that a scientific tariff is essential. It should be constructed, it says, "by a Tariff Board of a permanent character composed of men of the highest standing and impartiality. The members of the Board should be removed as far as possible from political influence by the terms and character of their appointment. Their position in regard to freedom from external influence should approximate as closely as possible to that of H.M. judges." The Board, having constructed the tariff, "should supervise its working, recommend any periodical amendments and adjustments which may be necessary, and deal with any cases of abuse of the advantages conferred by the tariff." As an outline, that is admirable, and the country may well hope that the Government will appoint, *at the earliest possible moment*, a body of the kind, but immediate action is becoming imperative, and, as we have suggested in our opening paragraph, sympathetic consideration now by the Board of Trade of the most urgent cases might lead to provisional measures which would be of immediate benefit.

Science in the House.

WE are following with some interest a discussion in the pages of our respected scientific contemporary, *Nature*. It appears that scientists, with the British Science Guild at their head, are disturbed by an alleged public indifference to science and, especially, by the fact that the spirit of science does not permeate the House of Commons. They are, we gather, anxious to see science more widely expanded through all ranks of society and in particular they desire, if we understand them aright, that no Act of Parliament should appear on the Statute Book until it has been weighed and examined by scientists. *Nature* itself, as one of the protagonists, exclaims that industrialists have associations "to safeguard their interests and, whenever circumstances demand, to express their collective views to Government and the general public. The same is true of the banks, financial houses, and trade unions, who all see that their interests are well represented in Parliament," but "Up to now, the scientific community has neither built up a strong representative body nor collectively assisted any of its members to enter the House of Commons, where the influence of ten or twelve members qualified to speak for science and backed by science would be disproportionately great in comparison with their numerical strength."

It is unfortunate that science, so particular about definitions, has never succeeded in defining itself. Hence we are left in some little doubt about the meaning in which that word is used by the disputants. But in order to make ourselves clear we propose to spell Science with a capital S when we mean Natural Philosophy, and with a small s when we speak of expert knowledge of other subjects. Let us examine the arguments in the light of this really fundamental difference. When *Nature* charges the nation with the failure "adequately to appreciate science and the scientific outlook" it is clear that it has Science in mind. When it says, further, that the nation has "a religious faith in the efficacy of science" it is equally certain that the cap S should be used. But the two statements appear to be in conflict; the nation cannot both fail to appreciate science and have a religious faith in it. It must do one or the other, and we should say that, on the whole, Science stands in a higher position to-day than it ever did. It has always been the plaything of the dilletante, but with the spread of technical schools, the adoption of Science by the great universities, and the wide expansion of popular books on scientific subjects, which now challenge the supremacy of "shockers" as best sellers, the leaven of Science is spread through the whole lump. Indeed, we may go even further and assert that so predominant has it become that there is an actual revulsion against it, just as there was a few years ago against Efficiency. But profound as the faith of the nation in Science may be, it does not carry it to the point of believing that men of Science in virtue of their logical minds would make better administrators than, let us say, merchants, lawyers, or historians; or that its opinion upon the maldistribution of gold and silver, the restriction of imports of manufactured goods and agricultural products, disarmament, factory legislation, Parliamentary Estimates, and similar matters—all enumerated by our contemporary—would carry more weight than that of acknowledged experts in these subjects. It might even swing to the other pole. It might say with fair justice that its acquaintance with men of Science shows them to be rather unpractical people, so immersed in the problems of Natural Philosophy that they make but little contact with the everyday world around them, and it might even go to the extent of saying that, whilst it would listen with the gravest attention to what the Scientist had to say about Science—as the House of Commons always does—it could not admit that its views on more mundane affairs were worthy of greater regard than that given to the opinions of ordinary men of sound common sense, and espe-

cially those who enjoyed long experience of the matters under debate. As a representative organ of an industry which is based, in part, upon the application of Science and is, in part, carried on by men with a scientific education and the scientific outlook, it is far from us to charge Men of Science with less capacity for the ordinary affairs of the citizen than other men; but at the same time we see no reason for thinking that their particular training has increased their capacity for handling such affairs. Rather do we take the view that any expert is a scientist in his own sphere. It shows no disrespect for Science if we say that the opinion of the President of the Institute of Transport on the use of railway containers would carry more weight with us than the joint opinions of the Presidents of the Royal Society, the Royal Institution, and the British Science Guild.

That occasions do arise in the House of Commons, and in other public assemblies, when technical subjects are discussed by men and women who know little or nothing about them cannot be gainsaid. But there are, fortunately, in both Houses members who have expert knowledge of technical and scientific subjects, and their services are generally sought upon appropriate committees. We do not know if they amount in numbers to the ten or twelve mentioned by our contemporary, but we should not be surprised to hear that they are even more numerous, unless the intention is to limit consideration strictly to Natural Philosophers. That may be the case, for the unhappy introduction of "trades unions" in the list of those whose "interests are well represented in Parliament" gives rise to the unworthy thought that the interests of Scientists and not of Science alone, have some weight with one of the protagonists. Let us say in conclusion that we would be the first to welcome the spread of the "scientific outlook" in Parliament. Our doubt is that the Man of Science, that is, the Natural Philosopher, would —certain subjects being excluded—be any more effective as a legislator than he who has given close attention to national problems and may justly claim to be regarded as a scientist with respect to them.

Experimental Work on Roads.

IN 1929 the then Minister of Transport appointed a Technical Advisory Committee on Experimental Work to be carried out under powers conferred by the Road Improvement Act of 1925. The Committee was constituted as follows:—Major F. C. Cook, D.S.O., M.C., M. Inst. C.E. (Chairman), representing the Ministry; Mr. F. G. Bristow, representing the Standing Joint Committee of Mechanical Road Transport Associations; Professor R. G. H. Clements, M. Inst. C.E., representing the Royal Automobile Club; Mr. T. Peirson Frank, M. Inst. C.E., representing the Institution of Civil Engineers; Mr. E. H. Fryer, representing the Automobile Association; Mr. W. J. Hadfield, M. Inst. C.E., representing the Institution of Municipal and County Engineers; Mr. H. Kerr Thomas, M.I. Mech. E., representing the Institution of Automobile Engineers; Mr. W. P. Robinson, representing the County Surveyors' Society; Sir Thomas Stanton, F.R.S., M. Inst. C.E., M.I. Mech. E., representing the Department of Scientific and Industrial Research, and Mr. Sidney Straker, representing the Motor Legislation Committee. On the death of Mr. Straker, Mr. F. S. Bennett was appointed to take his place.

This Committee has recently issued its first Annual Report,* covering the period from July 16th, 1929, when it held its first meeting, up to December 1st, 1930, and we propose in what follows to give a brief summary of the principal points dealt with in that document.

The Report is divided into eleven chapters, the first being devoted to General Matters. It is explained that, at the time when powers were obtained, in the Roads Improvement Act of 1925, for the carrying out of experimental work, no facilities, either from the point of view of staff or equipment, existed for such work in the Roads Department, and that, accordingly, the National Physical Laboratory had been asked to put in hand certain researches. These researches fell into three main groups:

(i.) Concrete.
(ii.) The conditions which give rise to the skidding of vehicles.
(iii.) Impact of vehicles on highways.

When the Advisory Committee began operations, researches under headings (i.) and (ii.) had been completed so far as the National Physical Laboratory was concerned, but research under (iii.) was still being continued. To enable experiments to be carried out under practical conditions without interference from general traffic and to enable particular road surfaces to be studied under known traffic conditions, arrangements had been made for the provision of an experimental length of road near which could be erected an experimental station, or laboratory, for carrying out scientific investigations into road problems. The general scheme was to construct an experimental road of approximately 450 yards in length, parallel to and immediately north of the Colnbrook By-pass, which might form a loop on to which the traffic might be diverted from the By-pass as desired. The Advisory Committee decided to carry on this work and to prosecute its investigations under the following headings:—

(1) Study of subsoils and their treatment.
(2) Foundations.
(3) Wearing surfaces or carpets.
(4) Surface dressing or treatment of surfaces.
(5) Factors affecting the resistance exerted by a road surface to a wheel sliding over it.
(6) Impact caused by vehicles moving along the road surface and movements and vibrations set up in the road material.

The chapter concludes with a description of what had already been done and what it was proposed in the future to do with regard to these matters.

THE EXPERIMENTAL STATION AT HARMONDSWORTH.

Chapter II. contains a description of the Experimental Station, which, it is explained, was erected at Harmondsworth on the Colnbrook By-pass. The station was furnished with the necessary machinery and plant for an engineering workshop, a 500-ton compression testing machine, a 20-ton weighbridge, a surface grinding and a concrete-mixing machine being provided in addition to laboratory and office equipment.

The Staff at the Station comprised a chief and an assistant road engineer, with a clerk of works, &c., and a Senior Scientific Assistant having under him assistants for concrete, chemical, mechanical and bituminous materials research, together with junior assistants, observers, mechanics, clerks, labourers, &c.

The principal researches instituted during the year 1930 were concerned with the following matters:—

(A) Concrete sections on the experimental road at Harmondsworth.
(B) Tests of joints in concrete slabs on the Chertsey arterial road.
(C) Laboratory research into the behaviour of concrete under practical conditions of road construction.
(D) Examination of existing concrete roads which had shown special features after construction.
(E) Measurements of changes in temperature of road slabs, and movements resulting therefrom.
(F) Surfacing tests on the Kingston By-pass.
(G) Laboratory research in connection with Asphaltic and bituminous materials.
(H) Research on Skidding.
(I) Research on the impact of vehicles on roads.

These matters are dealt with in subsequent chapters.

CONCRETE SECTIONS ON THE HARMONDSWORTH EXPERIMENTAL ROAD.

The length of the road is about 600 yards, of which some 450 yards are available for experimental purposes. The first set of experiments was directed to the determination of the effects in road construction of varying thickness; reinforcement, single and double; foundations of different natures and materials, &c. The method of mixing, the cement and aggregates used, the water/cement ratios, sizes of slabs, joints, &c., are discussed, and the following summary is given regarding the results arrived at in the investigations:—

(*a*) The slabs showing the least length of transverse cracks were those with top and bottom reinforcement, any advantage observed being in favour of slabs 6in. thick.

(*b*) The unreinforced slabs with the least length of transverse cracks were those of 8in. "wet" concrete laid on wet clinker.

(*c*) The experiments on the treatment of foundation and on the water/cement ratio had been inconclusive at the date of the Report.

(*d*) 45ft. slabs showed nearly twice as many cracks as 30ft. slabs of similar construction.

(*e*) No difference was noted during the year between slabs treated with silicate of soda and those not so treated.

(*f*) Abrasion of the road surface was found to be negligible.

(*g*) It is essential that the closest attention should be paid to detail during construction, and that there should be strict supervision of materials and workmanship.

The findings of the Committee in these questions are illustrated by means of tables and curves.

TESTS OF JOINTS.

It was decided by the Committee to collaborate with the County Engineer of Surrey for the purpose of carrying out tests on different types of joints on a portion of the Chertsey Arterial Road. The experimental portion chosen was 480 yards long, with a carriageway 40ft. wide between kerbs, and having a longitudinal joint down its centre with transverse joints every 20ft. The entire section is on a curve of 1500ft. radius and there is a super-elevation of 9in., the crossfall being constant. The concrete is 9in. thick throughout with top and bottom layers of reinforcement, both of which have 2in. cover, the subsoil consisting of loam on gravel. The concrete was laid on a bed of consolidated clinker, 3in. thick, which was well wetted before the concrete was placed.

Details are given of the methods of mixing, placing and maturing of the concrete, as well as of the joints, and an account is added of the tests on materials, concrete, &c., which were carried out at the experimental station, while constructional work on the road was in progress.

Sufficient time had not elapsed between the completion of the road and the date of the Report for the results of observations on the behaviour of the joints to be embodied in the latter.

LABORATORY WORK ON CONCRETE.

The Committee recognised that pure research on cement and concrete was the function of other organisations and that it should, more particularly, interest itself in the study of factors which influence the construction of concrete roads, and in devising means for controlling the quality of the material in actual practice. Accordingly, the experimental work on concrete was mainly confined to the development of tests suitable for being carried out in the field. A certain amount of work was also done in connection with the preparation of slabs for testing a core-cutting machine which it was decided to buy, and for experiments on the expansion of concrete.

During the formation of the experimental portion of the Chertsey arterial road, it was found that considerable discrepancies occurred between the water/cement ratio as determined by analysis and as determined from the amount of moisture in the materials and of water added to the materials. Efforts were therefore directed to eliminate the source of these errors, and laboratory experiments were begun with that object in view. Two sources of error presented themselves, namely (*a*) the technique of the method, and (*b*) the method of sampling the mix at the mixer. Both those possibilities were investigated, and, as a result, it appeared that the method of sampling a mix has a very definite bearing upon the value of the water/cement ratio determined by analysis. It became evident that the sampling of a mix after dumping gives very illusive results, and should be deprecated. On the other hand, sampling a mix by taking random scoopfuls of concrete as it falls from the mixer gives more satisfactory results with the larger-sized samples. In spite, however, of the discrepancies occurring in water/cement determinations, it is felt that they do impose a very useful check upon the mixing of the concrete, and the Committee considered it to be well worth while pursuing the investigations, so that the test might be made of added utility in the future.

Other matters which received attention, as discussed in this chapter, were:—The determination of moisture in aggregate and sand; mechanical tests in the laboratory and in the field; grading; voids; cleanliness, &c. The organisation for dealing with work on cement and concrete was developed considerably during the year, and sufficient apparatus to enable accurate and reliable tests of all kinds to be performed was made available.

EXAMINATION OF CONCRETE ROADS SHOWING SPECIAL FEATURES AFTER CONSTRUCTION.

In the beginning of 1930 it was noticed that the number of defects in an arterial road with a concrete foundation was increasing rapidly, and it was decided to make frequent inspections in order to note their extension and to try and formulate conclusions as to their causation. The Report explains that the road was about 3 miles long and 30ft. wide, and was formed of bays 14ft. 6in. long, extending the whole width of the road with no centre joint. It then proceeds to describe the sub-soil, foundation, surface, kerbing, &c., of road, and to recount the investigations carried out in connection with the defects. These investigations were not completed at the date of the Report, but it is stated that the following two important conclusions might be drawn from an examination of all the factors established up to that time:—

(1) The positions and forms of the depressions indicated that failure was caused by actual movement of the concrete slabs as traffic passed over them, despite the protection of the carpet, which was of asphalt.

(2) The only general failure occurred at the joints, and, had they not failed, it is probable that the road would still be in good condition.

MEASUREMENT OF CHANGES OF TEMPERATURE.

When plans were being prepared for the construction of the experimental road at Harmondsworth, it was decided to make tests of the changes of temperature in one of the slabs and of the movements of the slabs which accompanied those changes. The tests included the measurements of temperatures at the top and bottom of the concrete road slab, and the variation in the length of the slab with temperature. It was also decided to institute an investigation into the phenomenon—previously observed elsewhere—that the corners of a slab curved relatively to the centre of the slab as the atmospheric temperature varied. The methods of procedure in each case are

* The Ministry of Transport, Roads Department, Technical Advisory Committee on Experimental Work: Report to December 31st, 1930. H.M. Stationery Office. Price 5s. 6d. net.

set out in the Report, and the results obtained are summarised in tables and graphs.

SURFACING TESTS ON THE KINGSTON BY-PASS ROAD.

So as to collect comparative data with regard to different road-surfacing materials, their first and maintenance costs, their lengths of life and anti-skidding properties on a road carrying fast and heavy traffic, the Committee determined to lay down some test sections incorporating various methods of modern road construction. The necessary work was carried out in collaboration with the County Engineer of Surrey, the Asphalt Roads Association, the British Road Tar Association, and the Road Emulsions and Cold Bituminous Roads Association. A part of the Kingston By-pass Road was chosen, and it was divided into eleven sections of 220 yards each.

The different types of surfacing employed were as follows :—

(1) 2in. single-coat asphalt (slag and sand aggregate).
(2) 3in. single-coat steam-rolled asphalt, B.S.S. 344.
(3) 4in. two-coat steam-rolled asphalt, B.S.S. 342.
(4) 1½in. compressed rock asphalt on a 2½in. binder course, B.S.S. 348.
(5) 1½in. mastic on a 2½in. binder course, B.S.S. 346.
(6) 3in. single-coat tar (pitch) macadam (slag aggregate).
(7) 3in. single-coat tar (pitch) macadam (granite aggregate).
(8) Two-coat cold asphalt, ½in. wearing course on a 1½in. binder.
(9) 2in. single-coat cold asphalt.
(10) Two-coat cold asphalt, ½in. wearing course on a 1½in. binder.
(11) Cold asphaltic concrete, 1½in. single-coat.

The Report states that the following were the main points observed on each section up to the end of the year :—

Section 1.—The "texture" of the road seemed to vary to some extent with temperature ; during cold weather the asphalt appeared to be more open than during warm weather.

Section 2.—There was some evidence of wear at the longitudinal joint, and, after rain, the joint did not dry out until the rest of the road was dry.

Section 3.—Nothing to report.

Section 4.—The surface chippings tended to break away, especially in the wheel tracks. This condition was particularly noticeable on the east side.

Section 5.—Nothing to report.

Section 6.—This section was not surface-dressed when laid, as it was desired to observe the effects of traffic upon the material without a dressing. The surface was subsequently dressed.

Section 7.—There was nothing special to report up to the end of the year, except that the surface appeared to be wearing somewhat smoother than it was when laid.

Section 8.—Nothing to report.

Section 9.—This section deteriorated in parts. The defects are attributed to insufficient consolidation of the northern half of the section. The south portion was in good repair.

Section 10.—Several cracks appeared in the asphalt over transverse concrete joints. Otherwise the section seemed to be in much the same condition as it was when new.

Section 11.—Several cracks appeared in the asphalt over transverse concrete joints. This section seemed to have improved during the 4½ months which had elapsed since it was laid.

Tests of different kinds which were made on these surfaces are entered into in considerable detail, with the aid of numerous Tables.

SKIDDING.

Skidding research during the period under review was mainly confined to work with a special motor cycle and sidecar. The eleven sections on the Kingston By-pass—referred to above—afforded an excellent opportunity for making comparative skidding tests, and research was mainly concerned with investigations into the behaviour of the surfaces on those sections. Tests were also made on the Harmondsworth By-pass. It is stated that the development of a four-wheeled vehicle, suitable for continuing the research, was under consideration.

IMPACT OF VEHICLES ON ROADS.

Under this heading are given, among other things, a description and illustrations of a special form of accelerometer, which was designed for the purpose of the investigations which the Committee decided to carry out. During the period covered by the Report, the instrument had not been used upon the road, but it had been used at the National Physical Laboratory, for some wheel-dropping experiments, with very satisfactory results.

The problem of road vibration was studied during the year at the experimental station at Harmondsworth, by attempting to measure the deflection and vibration of roads under the impact of passing traffic. The first set of tests was made by officers of the National Physical Laboratory, with an instrument which they had designed and built. Subsequently a deflectometer of a somewhat different pattern, which was designed and constructed at the Harmondsworth station, was employed.

Observations were made of the vibrations caused by :—

(1) Motor cars and motor cycles.
(2) Motor omnibuses and coaches ;
(3) Commercial motor vehicles ;

as well as by combinations of them. The results observed are shown in a series of graphs.

British Standards Institution.

THE British Standards Institution began life in 1901 as the Engineering Standards Committee, a body set up by the Institutions of Civil, Mechanical, and Electrical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute. In 1918 it became the British Engineering Standards Association and in 1929 it received a supplemental Royal Charter, whereby it was incorporated as the British Standards Institution, and authorised to extend its consideration of standardisation questions as they arise, not only in the engineering industry, but in the chemical, building, and textile industries. The Institution as reorganised is now governed by a Grand Council, on which each of the divisions is equally represented, and each division is governed by a Divisional Council.

The Engineering Divisional Council has working under it a number of Industry Committees, which control the standardisation work in their respective branches. The classification into industry committees is based on broad lines, no rigid delimitation of duties is laid down, and between all sections of the organisation there is the fullest co-operation. The Industry Committees under the Engineering Divisional Council cover the following sections of engineering :—Aircraft, automobile, chemical, colliery, electrical, gas, mechanical, non-ferrous, oil well, public works, ships, illumination, and iron and steel. Of these committees, the Mechanical Industry Committee is responsible for all the standardisation work arising in connection with mechanical engineering, while the Public Works Industry Committee deals with standardisation as it affects roads, railway and tramway permanent way, bridges, and other subjects commonly regarded as coming within the field of civil engineering. The detail work of the Industry Committees is conducted by Technical Committees, of which there are thirty-six in the Mechanical Section and eleven in the Public Works Section. As an indication of the extent to which the British Standards Institution has now drawn to itself the support of outside bodies, it may be remarked that the Mechanical Industry Committee, which, as has been indicated, is one of the thirteen industry committees acting under the Engineering Divisional Council, numbers over fifty members, and includes representatives of the Admiralty, War Office Home Office, India Office, the Crown Agents for the Colonies, the Office of Works, Ministry of Transport, Department of Scientific and Industrial Research, the Institutions of Mechanical, Automobile, Gas and Heating and Ventilating Engineers, the four railway groups, the engineering insurance companies, the British Engineers' Association, the BEAMA, the National Federation of Iron and Steel Manufacturers, the Locomotive Manufacturers' Association, the Machine Tool Trades' Association, the Association of British Chemical Plant Manufacturers, the Agricultural Engineers' Association, the Institute of Marine Engineers, and the British Marine Oil Engine Manufacturers' Association.

Although it is supported in this manner by numerous Government Departments and representative organisations, the British Standards Institution is an entirely independent body, and is free from Government control. It exists to assist British industry by preparing British Standard Specifications which are based on what is best in current practice, but which do not attempt to attain an ideal that might be very costly to adopt. The Institution does not make profits. Apart from a Government grant and the proceeds derived from the sale of its publications, it has to rely on British industry for the funds required to carry on its work. Every British firm and every individual engineer is eligible to become a member of the Institution at a nominal fee. Membership carries with it some valuable privileges and advantages, and the co-operation and assistance of all manufacturers and others in the engineering industry are sought for the promotion of the Institution's work.

Over 430 British Standard Specifications have now been issued. That the economic value of the work done by the Institution is widely recognised is testified to by the increasing amount of standardisation which it is being asked to undertake. In the Mechanical Section, British Standards have long been available for many items entering into the mechanical engineer's work, such as screw threads, bolts and nuts, and pipe flanges. Among the specifications issued during the past year of interest to mechanical engineers, are those relating to steel tub wheels and axles, shaker conveyor troughing, attachment of circular saws, lathe centres, dimensions of indicator cocks, leather belting, diamond pyramid hardness numbers, riveted, forged, and solid drawn compressed air receivers, manilla ropes, ships' cargo-lifting blocks, boiler rivets, valve fittings for cylinders, gas cylinders and test sieves. Among the subjects at present under consideration in the Mechanical Section, three are of outstanding interest. In connection with land boilers, committees are at work preparing specifications for Lancashire, Cornish, vertical, water-tube, locomotive, and heating boilers, unfired pressure vessels, fittings, accessories, pipes and piping, and boiler and superheater tubes. In connection with gearing, a draft specification is nearing completion dealing with spur and helical gearing, and attention is about to be turned to the preparation of specifications for bevel and worm gearing. Thirdly, a fully representative committee is considering the preparation of specifications for welding. Sub-committees are actively at work dealing with standard nomenclature and definitions for welding, electrodes, and parent metal, welding as applied to steel structures, the testing of welders and the fusion welding of unfired pressure vessels. Other subjects now under consideration in the Mechanical Section include pump tests, chain fittings, electric overhead travelling cranes, rubber conveyor belting, pipe flanges for pressures between 200 lb. and 1400 lb. per square inch, engineers' files, grinding wheels, taps and dies, marking and colouring of foundry patterns, engineering symbols and abbreviations, plummer blocks, testing of metal sheet and strip, and fibre cores for wire ropes.

In the Public Works Section a number of specifications relating to road construction have already been published. Standardised gauges of broken stone and chippings for macadam construction and surface gritting are available, and three grades of tar for tarmacadam manufacture and surface dressing have been standardised. Seven specifications are devoted to asphalt surfacing by the hot process. Some recently issued specifications deal with granite and whinstone setts, asphaltic bitumen road emulsion for grouting, and surface dressing and cold asphalt macadam constructed by the penetration method using emulsion. These specifications are to be followed shortly by others dealing with cold processes of asphalt road construction. In connection with footway construction, specifications are available for concrete paving flags and for concrete kerbs and channels, while there has recently been issued a specification for granite and whinstone kerbs and channels.

For the steel bridge designer specifications have been published giving lists and properties of structural sections. Other specifications relate to structural steel and to the workmanship, details of construction, and loads and stresses in the bridges themselves. There is shortly to be issued an important specification relating to the minimum requirements for the use of structural steel in buildings. This specification has been prepared as a result of the report of the Steel Structures Research Committee. Another revision of the well-known British Standard Specification for Portland Cement was recently issued, and there will shortly appear a specification for high alumina cement. Among other specifications now being prepared is one for steel railway sleepers.

Standard specifications for salt-glazed ware pipes and cast iron pipes for water, gas, and sewage, have been available for some time. Steel and asbestos cement pipes for the same purpose are now being standardised. Among other specifications which are being prepared are those for salt-glazed glass-enamelled fireclay pipes, sand lime bricks (revision), cast concrete roofing tiles, salt-glazed ware drain fittings, building limes, and asphalt for roofing.

An interesting event in the history of the Institution took place on Thursday of last week, January 14th, when, with the aid of wireless telephony, it held a joint meeting with the Standards Association of Australia. Reference to this meeting is made in our Seven-day Journal this week.

BOOKS RECEIVED.

Building Societies Year Book, 1931. Compiled and edited by G. E. Franey. London : Reed and Co., 37, Cursitor-street, E.C. 4. Price 7s. 6d. net.

Hydro-electric Development of the British Empire By J. E. Robbins, M.A. London : Macmillan and Co., Ltd., St. Martin's-street, W.C. 2. Price 5s. net.

Jane's Fighting Ships, 1931. Edited by Oscar Parkes, O.B.E. London : Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 42s. net.

Problems in the National Teaching of Science. By Professor I. Masson, M.B.E., D.Sc. London : The British Science Guild, 6, John-street, W.C. 2. Price 1s. net.

Machinery and Plant Depreciation Tables, 5 per cent. to 20 per cent. on the Diminishing Value. London : Gall and Inglis, 13, Henrietta-street, W.C. 2. Price 4s. net.

Steam Turbine Theory and Practice. Third edition. By W. J. Kearton. London : Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 15s. net.

A Treatise on Photo-elasticity. By E. G. Coker, M.A., D.Sc., &c., and L. N. G. Filon, M.A., D.Sc., &c. London : Cambridge University Press, Fetter-lane, E.C. 4. Price 50s. net.

Fuel Research Technical Paper 32 : A Study of the Tars and Oils Produced from Coal. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. net.

The Deterioration of Structures in Sea Water. Edited by J. Purser and H. J. Grose. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

Jane's All the World's Aircraft, 1931. Edited by C. G. Grey. Compiled by L. Bridgman. London : Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 42s. net.

The Official Year Book of the Scientific and Learned Societies of Great Britain and Ireland, 1931. London : Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 10s. net.

Architects' and Builders' Handbook. Eighteenth edition. By the late F. E. Kidder. Editor-in-chief, H. Parker. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 50s. net.

The "Practical Engineer" Electrical Pocket Book and Diary for 1932. Edited by C. Arnold, A.M.I.E.E. London : Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 2s. 6d. net.

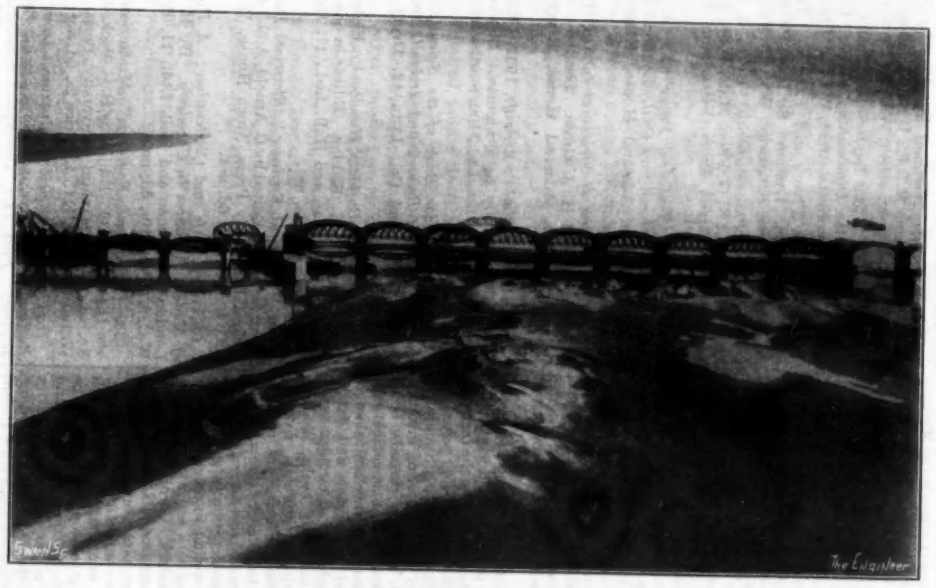
Chemistry, Life and Civilisation : A Popular Account of Modern Advances in Chemistry. By H. J. S. Britton. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 10s. 6d. net.

The "Practical Engineer" Mechanical Pocket Book and Diary for 1932. Edited by E. G. Beck, A.M. Inst. C.E., &c. London : Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 2s. 6d. net.

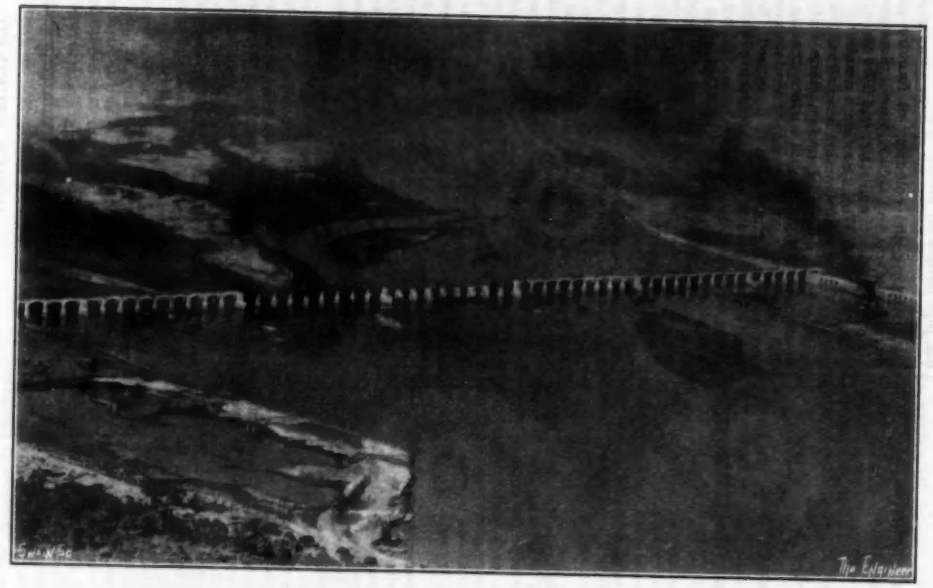
Handbooks of the Science Museum. Land Transport III.: Railway Locomotives and Rolling Stock : Part I., Historical Review. Part II.: Descriptive Catalogue. By E. A. Forward. London : His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price, Part I., 2s. 6. net ; Part II., 2s. net.

THE LLOYD BARRAGE AT SUKKUR—AERIAL VIEWS TAKEN DURING CONSTRUCTION

(*For description see opposite page.*)

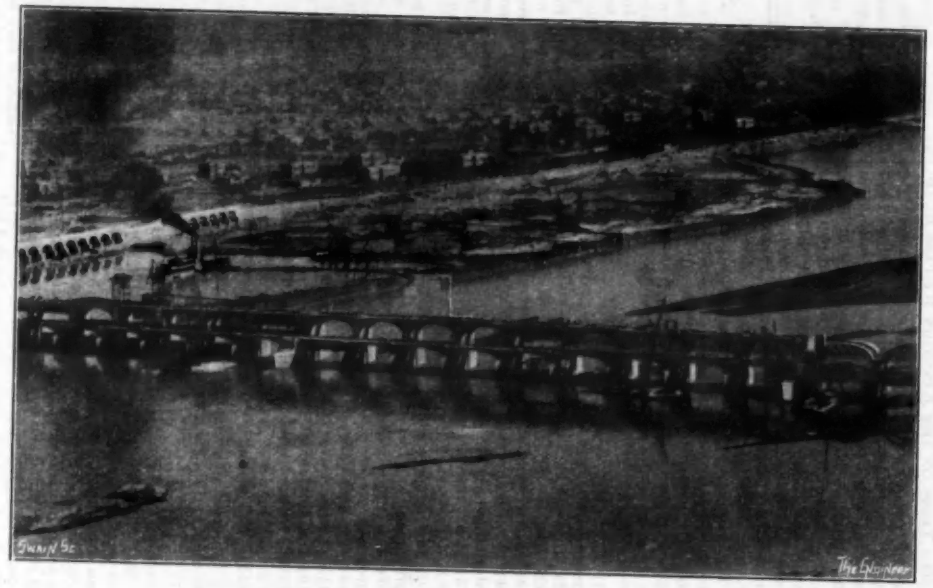


FORMING UPPER ROW OF ARCHES



PIERS FOR CENTRAL PORTION COMPLETED—FORMING ROADWAY ARCHES

DOWN-STREAM VIEW, SHOWING CONSTRUCTION OF UPPER ROW OF ARCHES



DOWN-STREAM VIEW, SHOWING CANAL HEAD-WORKS

The Lloyd Barrage at Sukkur on the Indus.

As we briefly announced in our issue of January 15th, the Lloyd Barrage at Sukkur, in the Province of Sind, was formally put into service on January 13th last by the Earl of Willingdon, Viceroy and Governor-General of India. We have on several occasions in the past—notably in our issue of August 25th, 1922—referred to this huge structure and its associated extensive network of irrigation canals—which constitute the largest irrigation system in the world and represent the greatest contribution to irrigation which has been made by British engineers—but, in order to make the following description complete in itself, we propose, in the present instance, to give a comprehensive survey of the whole undertaking.

From remote ages, the silt, brought down from the hill country by the Indus, has been deposited in the plains of Sind, making them among the most potentially fertile areas in the world. Unfortunately, however, the rainfall over the district is scanty and fitful, and, for centuries, agriculturalists have had to rely upon the water in the river for the adequate irrigation of their crops. But, again unfortunately, the River was unreliable. With the sudden melting of the snows on the high hills among which it has its origin, its waters might come down in a mighty flood, but it was beyond the skill of man to predict when those floods would arrive or how long they would continue. Then again, with the recurrence of colder spells in the mountains, the melting of the snows would cease, and the flow become less and less till, finally, the level of the river might fall so low that water could no longer be diverted into such irrigation canals as existed. It was not an unknown thing, in the past, in fact, for many thousands of acres of crops in full growth to be absolutely ruined by the supply of water failing before the time of harvest had come, and for famine to result. On the other hand, floods might arrive so early in the year that the farmers were not prepared to take advantage of the early favourable level. The new barrage is designed entirely to do away with these serious irregularities.

It had long been recognised that the only way in which successfully to end the uncertainty in the supply of water was to throw a barrage at some point across the River. As long ago as 1846, Lieut.-Col. Walter Scott, Superintendent of what was originally the combined Canal and Forest Department in Sind, proposed to construct a solid dam, but the suggestion was negatived as being certain to cause the River to alter its course. A few years later, Lieut.—afterwards General—Fife, R.E., made an able Report on the whole question of the irrigation of Sind, and he proposed that six great canal systems, which would make the best use possible of the natural flow, should be constructed; but nothing was done at the time. The question of the irrigation of Sind was again considered by the Irrigation Commission in 1901–03. That body, however, though it discussed the possibility of building a weir at Sukkur, did not consider such a structure necessary at the moment, and, in fact, made no practical proposals.

In 1904, Dr. Summers, the then Superintending Engineer, Indus Left Bank Division, investigated the matter still further, but, though he was convinced that it would eventually be necessary to construct a barrage, did not consider that it was immediately imperative to provide one. The Government of Bombay did not, however, endorse that view, and it ordered a scheme, to include a barrage and canals on the Left Bank only, to be formulated. The project, when developed, was submitted first to the Government of India and then to the Secretary of State, who appointed a Committee of experts in London to examine it. The Committee reported that it considered the scheme premature and proposed that an alternative site for the barrage should be investigated. The Government of Bombay did not agree that the suggestion was premature, and in March, 1916, it obtained the consent of the Government of India to the preparation of a complete scheme to include a barrage and canals on both banks of the Indus. In consequence of the War, however, it was not possible to do anything until June, 1918, when the matter was again taken up and vigorously proceeded with.

A complete scheme was got out by Mr. A. A. Musto, Executive Engineer, who submitted it to the Government of Bombay in July, 1920. That body, after scrutinising it, in its turn submitted it to the Government of India, which, in December of the same year, forwarded it, with the recommendation for its acceptance, to the Secretary of State. Sanction having been given in April, 1923, arrangements were immediately made for financing the undertaking, and structural work on it was begun on July 1st of that year.

Briefly described, the scheme comprises :—

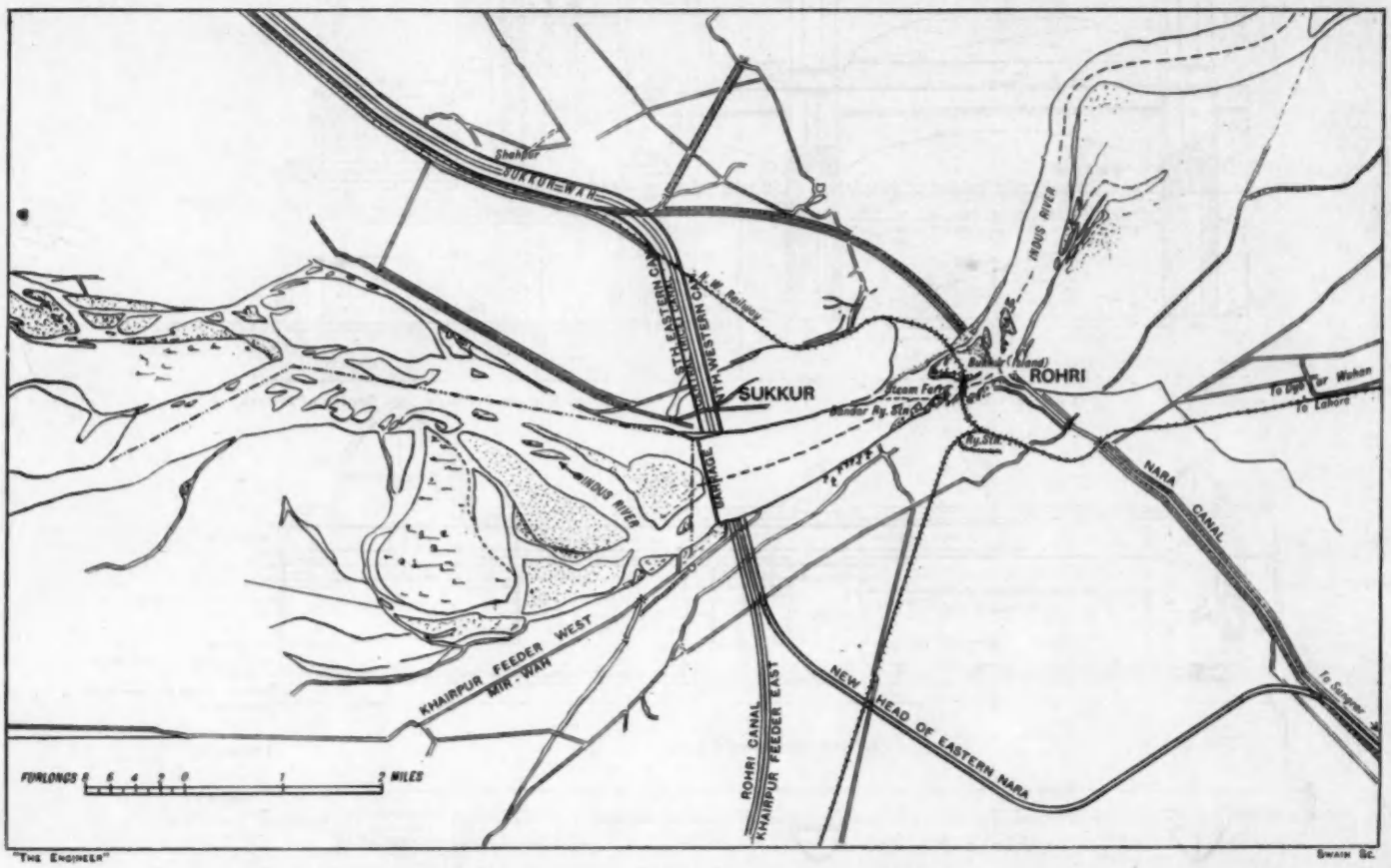
(i.) The construction of a Barrage across the Indus about 3 miles below the Lansdowne Bridge at Sukkur, and

(ii.) The excavation of seven main canals with their branches, distributaries, minors and watercourses.

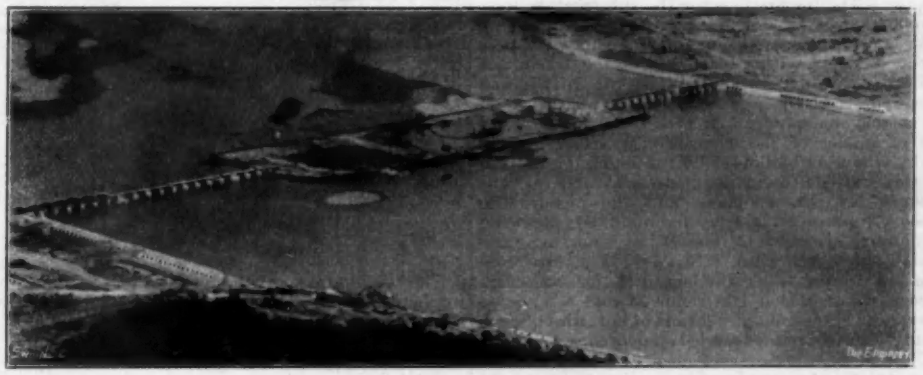
THE BARRAGE.

The barrage, drawings of which were given in our issue of August 25th, 1922, and are reproduced herewith, is nearly a mile long, the substructure being of limestone, above which there are two sets of arches forming sixty-six spans of 60ft. each, and constituting what are, virtually, two bridges at different levels. The upper or "Gate Bridge" forms a continuous platform from which the gates controlling the openings formed by the spans are manipulated; while the lower, called the "Road Bridge," is for road traffic and connects the main road on the right bank of the River with that on the left bank. The arches forming both bridges are built of reinforced concrete. The cill level of the Barrage is at R.L. 177·0 (?176), and the structure will be used to head-up water to R.L. 194·5, at which level all the new canals can obtain their required full supply of water. The R.L. of the springing of the gate bridge arches is 219·0 and that of the springing of the road bridge arches is 201·0. The regulation of the openings in the Barrage will be effected by means of steel gates—made by Ransomes and Rapier, Ltd.—each of which weighs 50 tons and which may be operated electrically, though they can also be worked by hand.

The five end spans on the right bank and the seven



PLAN OF BARRAGE SITE SHOWING HEADS OF CANALS



AERIAL VIEW SHOWING COFFERDAM FOR CENTRAL PORTION OF BARRAGE

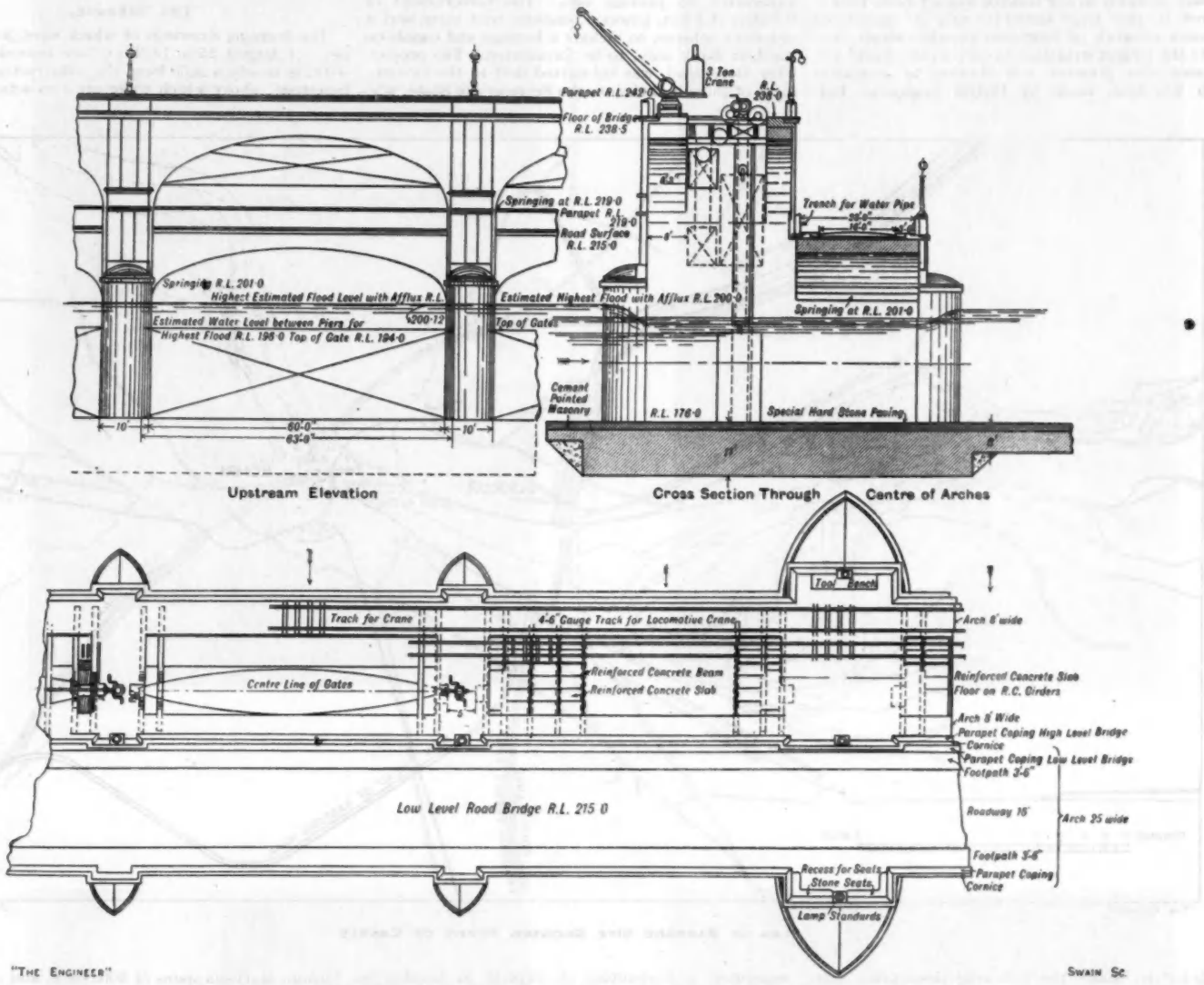
on the left are to be used as scouring sluices. Two long divide walls—one on the right bank, 1690ft. in length, and the other on the left bank, measuring 1975ft. in length, have been constructed to divide the River into three compartments. The arrangements are such that the levels and velocities of the water in them can be carefully controlled to suit the required conditions of entry of water into the canals.

The Barrage was constructed by means of cofferdams formed round each year's area of operations. The cofferdams were constituted by lines of interlocking steel piles driven into the river bed by pile drivers mounted on pontoons. Inside the wall of piles was a backing of sand, which was deposited by dredgers to a little above water level in the river. Soil brought from the banks by means of animal haulage was also used to some extent for the same purpose. The foundations for the substructure were excavated by means of dredgers working within the cofferdams, in which openings were left for the egress of the dredgers when they had effected the major portion of the excavation. When the vessels had been removed, the cofferdams were closed, and the water was pumped from the enclosed areas. The remainder of the excavation was then carried out by labour and followed by the laying of the upstream and downstream protection and of the masonry for the pavement and the piers. The masonry work proceeded day and night, the site being illuminated at night by electricity generated in a specially-provided plant. Sheet-piled sumps were arranged within the cofferdam area for collecting seepage water, which was removed and discharged outside the sheet piling by means of batteries of electrically-operated pumps carried on pontoons.

The materials necessary for construction—such as stone, mortar, &c.—which had previously been kept ready in the required quantities, were conveyed to the site within the cofferdam by means of broad and narrow gauge railways. As a total, some 42 miles of broad gauge, and 24 miles of 2ft. gauge lines were laid, and locomotives were employed for traction. Numbers of country boats were also used for the carriage of materials.

The Canals.

A quite suitable epithet to describe the system of canals which have been excavated as part of the scheme of irrigation is "stupendous." Seven main canals, totalling together 1040 miles, have been formed—three of them on the right bank and four on the left. These canals are known respectively as :—(1) The North Western ; (2) the Rice ; (3) the Dadu ; (4) the Eastern Nara ; (5) the Rohri ; (6) the Khairpur Feeder West ; and (7) the Khairpur Feeder East. Three of the seven have bed widths greater than that of the Suez Canal. The leading particulars of these canals and their accessory works are given in the accompanying table, which is reproduced from a brochure that was prepared for the opening ceremony, from which much of the information contained in the present article has been obtained.



Elevation, Section and Plan of Portion of Barrage

These figures, it may be explained, represent the labour of 3800, 2100, and 1100 men respectively, working daily for the whole month. The total capacity of all the machines taken together was, roughly, 74 tons of earthwork excavated and dumped per minute, which represents the labour of nearly 32,000 men working all the year round, or of about 77,000 men working for a seasonal period of five months of the year. In some parts, the excavation was carried out by *keens*, a primitive way of scraping up and depositing the earth outside the canal bed by means of a pair of bullocks drawing a metal-edged board scoop.

Particulars of Canals.

Items.	North-Western Canal.	Rice Canal.	Dadu Canal.	Eastern Nara.	Rohri Canal.	Khairpur Feeder West.	Khairpur Feeder East.
Area commanded, acres	1,037,395	543,614	667,534	2,326,591	2,831,024	—	—
Cultivable area, acres	939,235	476,498	582,035	2,195,384	2,545,609	—	—
Final area of annual cultivation, acres	563,000	357,000	412,000	1,627,000	2,043,000	298,000	
Maximum discharge at head, cusecs	5,152	10,215	2,837	13,649	10,883	1,936	2,094
Bed width at head, feet	165	243	92·5	346	247	79	82
Full supply level at head	193·90	194·00	194·04	194·20	192·50	193·50	192·50
Length of the main canal, miles	36	82	131	525	208	45	13
Length of branches, miles	171	5*	52	215	277	—	—
Length of distributaries and minors, miles	678	65*	441	1,212	1,937	—	—
Length of escapes, miles	—	—	29	9	35	—	—
Length of watercourses, miles	3,300	258	2,486	5,000	20,000	—	—
Spans 25ft. each in the head regulator	6	13	4	16	12	2	2
R.L. cill of head regulator	183·75	183·13	184·32	181·54	188·30	185·48	187·48

* Does not include 305 miles of old channel to be remodelled.

The excavation of the canals was effected by mechanical excavators and by hand labour. It was decided to use mechanical labour for the following reasons :—

(1) Because the necessary force—some 135,000 men—would not have been easily available ;

(2) Because the output of machines would be continuous and not affected by seasonal considerations ;

(3) Because the machines would work at rates which would control the cost of excavation by manual labour ; and

(4) Because any excessive demand for local labour would have adversely affected agricultural operations in Sind.

The results achieved are said to have fully justified the use of mechanical excavators. The total amount of earthwork completed up to the end of last year was about 569 crores—say, 5,690,000,000—of cubic feet, of which over 54 per cent. had been done by machines. A fleet of forty-six machines—nine of the largest type, seven medium-sized, and thirty small—costing together some £800,000, was assembled. The record monthly outputs of each type of machine were :—

Large size	5,660,000 cubic feet
Medium size	3,220,000 "
Small size	1,610,000 "

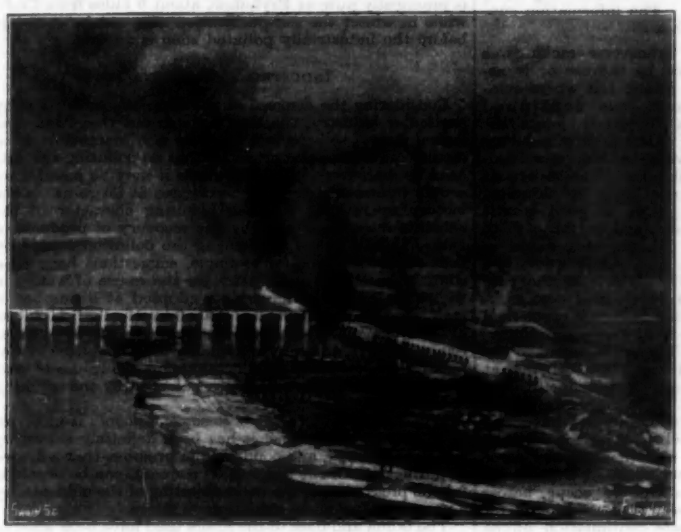
General Particulars.

It will be of interest here to set down a few important facts and figures in connection with the Barrage and its system of canals. The whole scheme, in accordance with the latest revised estimate, is to cost no less than £15,000,000, of which £4,300,000 represents the total estimated cost of the Barrage and Head Works. The total length of canals of all

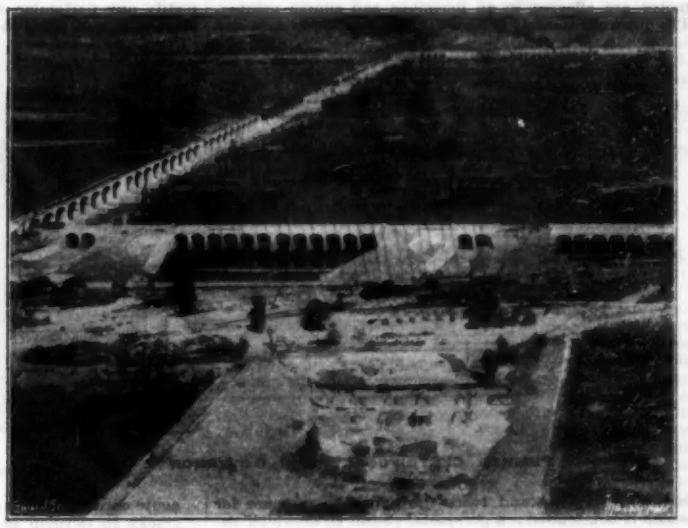
sizes excavated and to be excavated is 6166 miles. The gross area—in British territory—commanded by the scheme is 7,400,000 acres, and the annual cultivation—in British territory—when the area is fully developed will cover 5,010,000 acres. The new area of virgin soil brought under command will be 1,950,000 acres. The three types of Government land which will come under command and their areas are :—Class A, good quality land, 1,058,928 acres ; Class B, fairly good quality land, 602,205 acres ; and Class C, poor quality land fit for rice and then only after washing, 289,400 acres. The total number of bridges and regulators to be constructed in connection with the canal system is 1970, and the total cost of all the machinery employed, inclusive of that of the dragline machines, amounts to the large sum of £3,400,000.

The following figures add further eloquent testimony to the immensity of the undertaking :—

(1)	Excavation done by dredgers and manual labour in connection with the Barrage and Regulators	87,920,000 cubic feet
(2)	Permanent pile driving	721,000ft.
(3)	Cement and lime concrete work	1,240,000 cubic feet
(4)	Rubble masonry in foundations	8,200,000 ,,
(5)	Superstructure masonry	3,400,000 ,,
(6)	Cut stone work	170,000 ,,
(7)	Reinforced cement concrete work	640,000 ,,
(8)	Concrete block work	700,000 ,,
(9)	Stone pitching	15,510,000 ,,



UPSTREAM VIEW WITH CANAL HEAD-WORKS ON RIGHT



BARRAGE WITH LEFT BANK REGULATORS IN FOREGROUND

YEARLY PROGRESS.

During the years 1923–24 and 1925–26 the work done included :—

(*a*) The acquisition of land ;

(*b*) The construction of quarters on both banks of the River for officers and labour ;

(*c*) The purchase and assembly of the necessary craft and plant ;

(*d*) The construction of the necessary railways ;

(*e*) The opening of quarries and the provision of power and machinery therefor ;

(*f*) The building and equipment of a main power-house ;

(*g*) The erection of workshops ; and

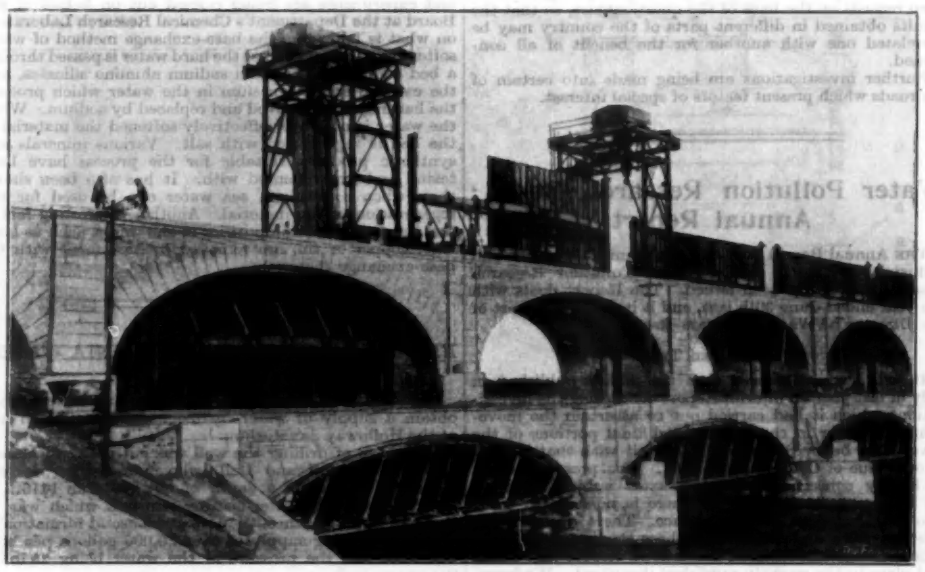
(*h*) The construction of the upstream guide banks.

In the season 1926–27 the construction of the regulators was begun and successfully carried forward, while in the year 1927–28 the actual underwater work in connection with the Barrage proper was initiated. In the same year 9½ spans on the left bank and 6½ spans on the right bank, as well as what remained to be done of the regulator foundations, were completed. The next year saw the formation of an additional ten spans on the right bank and thirteen spans on the left bank ; while in the year 1929–30 the central twenty-seven spans were finished. The divide walls and pavements were formed in the year 1930–31. The superstructure work was carried forward as the underwater work was being completed, and the whole Barrage, including the hanging of the control gates and their accessories, was finished by the end of last year.

The excavation of the canals was begun in the year 1925–26 and the quantities of earthwork excavated during that and subsequent years for the main canals, branches, distributaries, and minors, and for the Manchar drainage scheme were :—

1925–26	264,200,000 cubic feet
1926–27	602,400,000 ,,
1927–28	590,600,000 ,,
1928–29	1,008,700,000 ,,
1929–30	1,166,900,000 ,,
1930–31	1,233,000,000 ,,
1931–32	824,000,000 ,,

All the work is expected to be finally completed and the accounts closed in the year 1934, but the canals are to flow during the present year.



ERECTING STONEY SLUICE GATES

CULTIVATION AND PRODUCE.

The ultimate annual area of cultivation—in British territory—is, as stated above, expected to be some 5,010,000 acres, on which it is anticipated that the following crops will be grown :—

Wheat	2,440,000 acres
Cotton	790,000 ,,
Rice	625,000 ,,
Jowari, Bajri, &c.	695,000 ,,
Pulses	53,000 ,,
Oil seeds	410,000 ,,

Expressed in the form of crops, those figures represent :—

Wheat	1,133,000 tons
Cotton	500,000 bales
Rice	447,000 tons
Jowari, Bajri, &c.	298,000 ,,
Pulses	15,000 ,,
Oil seeds	117,000 ,,

CONCLUSION.

It would be impossible here to set out the names of all the engineers who have been engaged on this most important work, for, at one time and another, there were upwards of 150 of them, though, of course, all were not employed at the same time. In addition to the name of Mr. A. A. Musto, who has already been referred to as the originator of the scheme, and who worked it out, mention must, however, be made of Sir C. S. C. Harrison, C.I.E., whose knighthood was announced by the Viceroy on the occasion of the opening ceremony, and who has been in charge of the whole of the operations, as Chief Engineer, from 1923 to date. To him we would tender our congratulations on the success of the work.

Photographs of various parts of the work are reproduced, herewith, and on page 104.

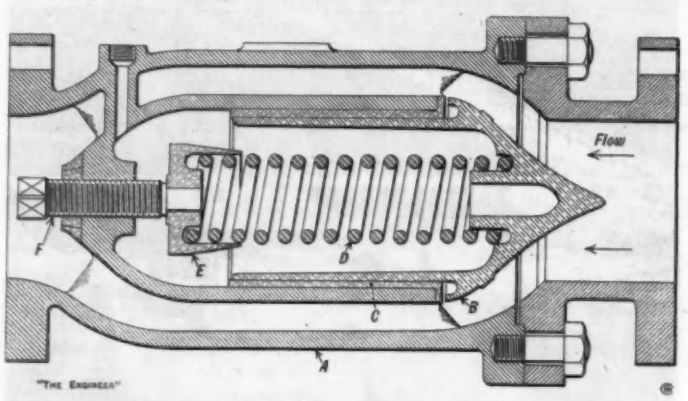
SIXTY YEARS AGO.

IN his presidential address to the Institution of Civil Engineers of Ireland—reprinted in our issue of January 26th, 1872—Mr. Bindon B. Stoney discussed three factors which were then exerting an important influence on the progress of engineering in this country. Firstly, there was the diminution in the hours of labour of the "working classes." The nine hours' day movement had made such rapid strides that what had, at first, to be fought for was being granted without even a request. The reduction in the hours of labour, Mr. Stoney remarked, was another step towards the improvement in the material prosperity of the working classes, an improvement which had shown itself markedly during the preceding twenty-five years. In part at least he attributed the increased prosperity to the influence of large gold discoveries on the price of labour. The workers, he said, had experienced a greater increase of prosperity than other classes of society. Incomes derived from professional toil had certainly not been augmented in the same ratio as those obtained by the exercise of manual skill. The second factor affecting the progress of engineering was the expiration of the Bessemer patents. Mr. Stoney apparently anticipated, as was the case, that the time was drawing near when steel would be the engineer's chief material. For the time being, however, he had to confess that long-cherished hopes in that direction were still unfulfilled. The skill of the manufacturer had not yet succeeded in overcoming the tendency of steel to fly to pieces without warning. The material was still regarded with distrust, particularly by shipbuilders, and its production in large quantities and with a reliable and uniform character had still to be realised. Iron, therefore, remained supreme for the time being. The third factor was the increased cost of coal. Many people believed, Mr. Stoney stated, that we should not be so liberal as we had been in supplying foreigners with a commodity of which we had a certain kind of monopoly as well as a limited supply. It was suggested that an export duty should be placed on coal, just as the Peruvians had, to their great gain, placed an export duty on guano. The cost of fuel, Mr. Stoney argued, was bound to go on increasing as the more easily won coal became exhausted, and deeper or thinner seams had to be worked. Those who had investigated the subject said that 4000ft. was the limiting depth at which coal could be mined profitably. At such a depth no wire rope of uniform size would be capable of sustaining its own weight, let alone lift a load of coal. The total lift would therefore have to be divided into three or more stages, an arrangement which would inevitably add considerably to the cost of the fuel.

THE official returns rendered to the Electricity Commissioners show that 1223 million units of electricity were generated by authorised undertakers in Great Britain during the month of December, 1931, as compared with the finally revised figure of 1150 million units in the corresponding month of 1930, or an increase of 6·3 per cent. During the year ending December 31st, 1931, the total amount of electricity generated by authorised undertakers was 11,401 million units, as compared with the finally revised figure of 10,914 million units for the year ending December 31st, 1930, representing an increase of nearly 4·5 per cent.

An Automatic Governor for Centrifugal Pumps.

AN extremely simple automatic governor called the "Pumreg," which can be adjusted to determine and control the maximum power which is absorbed by a centrifugal pump, is now being put on the market by Holden and Brooke, Ltd., West Gorton, Manchester. It is well known that a sudden drop in head may cause serious overloading of the driving motor and result in a burn-out unless a sufficiently large margin of power is provided, which is neither desirable nor economical. With the "Pumreg" governor—a sectional view of which is given herewith—the control of the pump and protection of the motor are effected in an ingenious and simple manner. The governor consists of a cast iron or steel body A, which



PUMREG CENTRIFUGAL PUMP GOVERNOR

is tested to withstand twice the hydraulic pressure for which it is intended; a gun-metal piston B, of which the valve forms an integral part, machined to fit accurately in the bronze liner C, which is anchored to the body; a powerful helical spring D of Monel metal or stainless steel; a spring carrier E of gun-metal which forms a guide for the spring, and an adjustable screw and lock-nut F, also of Monel metal.

The operation of the regulator is simple. The spring D is adjusted so that the control valve B is charged to a predetermined pressure corresponding to the normal prevailing head conditions. Should the external pressure on the hydraulic system fall below this the valve B will move forward and close, or partially close, the annular space shown and maintain the original pressure at the pump discharge branch, the effect being similar to but more sensitive than that obtained by hand control of a sluice valve at the pump outlet and being, of course, automatic. When the pump is shut down the spring closes the valve B completely and isolates the pump. When the pump is again started and run up to speed, the hydraulic pressure generated acts against the face of the valve and opens it sufficiently to give the predetermined quantity and head. Should the external head fall the valve, owing to the action of the spring, closes partially and so stabilises the quantity of water passing and thus overloading of the power unit is prevented.

One of the uses to which this automatic governor can be applied with advantage is in connection with filtration plants, where the head varies according to the resistance offered by the filtering material, while the quantity of water to be passed remains constant. It is equally adaptable to pumps for boiler feeding, mine sinking and mine drainage, or to any class of work where stability of output is a feature of paramount importance.

We have had an opportunity of viewing the governor in operation under ordinary working conditions at the makers' works and can testify as to its sensitiveness and efficiency.

The Design and Behaviour of Concrete Roads.

THE Secretary to the Ministry of Transport has made the following announcement:—

The Technical Committee appointed to advise the Minister on experimental work being of the opinion that if details of the design, construction, maintenance and behaviour of the concrete roads already laid in Great Britain could be collected and examined, it might be possible to draw conclusions helpful in future design, a questionnaire was issued to highway authorities in Great Britain. The information asked for included such points as the road conditions: width, gradient, subsoil, traffic, &c.; (*a*) concrete: thickness, reinforcement, consistency and proportions; (*b*) aggregates: material, gauge and grading the cement; (*c*) methods employed: batching, mixing, placing and curing; (*d*) joints and jointing materials; (*e*) cost of the work; and (*f*) results obtained: cracks, abrasion.

The comparatively small number of replies received, the relatively large number of variable conditions involved, and the somewhat indefinite answers given to many of the questions make it difficult to draw definite conclusions, but some of the most interesting variations of practice indicated by the 132 replies received were:—

(*a*) 102 roads were laid as two-course and 30 as single-course concrete.

(*b*) 90 per cent. of the roads were from 6in. to 8in. thick, though one road was 10½in. thick, and the thinnest road, which was laid on an existing macadam road carrying light traffic, was only 5in. thick.

(*c*) In roads built on the continuous system, the intervals between transverse joints were generally from 40ft. to 60ft., though in one case the interval was as small as 12ft., and in two others as high as 100ft. In roads constructed on the slab principle, the slab length was generally 15ft. or 16ft., though lengths of 30ft., 40ft., 60ft., and even 80ft. occur.

(*d*) Sixteen roads were of unreinforced concrete, 3 were reinforced at the top only, 82 at the bottom only, 31 were reinforced both top and bottom.

(*e*) The period of curing varied from two days to more than four weeks, damp earth or sand being by far the most usual method employed. Silicate of soda was employed for curing six roads.

(*f*) The costs of 82 per cent. of the roads lay between 1s. and 1s. 9d. per square yard per inch of thickness.

It was found impossible to determine from the replies the influence of any one detail of construction or to separate the effect of one detail from another in such a way as to justify any particular conclusion. The information supplied, however, tends to suggest that:—

(*a*) Transverse cracking was reduced by the use of transverse joints, but where reinforcement was continued across transverse joints the value of the joint in reducing transverse cracks was considerably less. This statement does not apply to dowelled butt joints, as good results were obtained in the case of three of the four roads in which such joints were used and the defects in the case of the fourth road were probably due to causes other than the type of joint employed.

(*b*) The arrangement of the transverse joints, whether at right angles or inclined to the kerbs, and whether in line or staggered, did not have any marked effect on the development of corner cracks; some reports indicated a tendency for cracks to occur across acute corners, and, in a few cases of staggered joints, for cracks to develop in approximate continuation of the transverse joint.

(*c*) The use of a longitudinal joint reduced the formation of longitudinal cracks.

(*d*) Roads in which no attempt was made to prevent evaporation of water during curing were more liable to crack than roads in which such precautions had been taken.

(*e*) Two-course roads did not withstand cracking so well as single-course roads.

(*f*) Roads laid on a wet sub-course cracked less than those laid on a dry sub-course.

(*g*) The six roads which were cured with silicate of soda were reported to be in very good condition.

The issue of this questionnaire will have directed the attention of road engineers to the importance of a number of factors in the construction of concrete roads which may not previously have received adequate consideration. For example, the degree of saturation of the clinker underbed—where used; measurements of materials—especially water; time of mixing and curing conditions. Review of the data emphasises the need for highway engineers to keep records on the lines of the questionnaire, so that the results obtained in different parts of the country may be correlated one with another for the benefit of all concerned.

Further investigations are being made into certain of the roads which present factors of special interest.

Water Pollution Research Board: Annual Report.

THE Annual Report to the Department of Scientific and Industrial Research of the Water Pollution Research Board has recently been issued. The Report deals with the year ended June 30th last, and it includes a Report of the Director of Water Pollution Research.

THE RIVER TEES.

It will be remembered that the Board published in July of last year an interim Report concerning the investigations which it had carried out to ascertain the movements of water in the estuary and tidal portions of the River Tees below Stockton. We dealt with that Report in our issue of October 16th, 1931. The present Report is largely concerned with the same subject, and as we have already discussed it, there is no need to enter into it again in the present instance. There are, however, other matters connected with these studies of the Tees which were not covered in the interim Report and which find place in the recently published document. We learn, for example, that in a zone from Middlesbrough to Stockton plant and animal life on the river bed is practically absent. That zone is subject to the greatest effects of pollution by sewage and effluents which contain specific poisons, and which lower the concentration of dissolved oxygen in the river. It, however, is also the zone in which the greatest changes in salinity occur, and the complementary experiments in the corresponding zone in the Tay estuary, which is comparatively unpolluted, have shown that the scarcity of life in the central part of the Tees estuary cannot be attributed solely to pollution.

Some 2500 smolts of trout and salmon found dead or dying in the upper part of the Tees estuary were collected, and from an examination of the bodies it appeared that their death could not be attributed to oxygen shortage alone. Chemical analysis of the effluents showed the presence of phenol and other tar acids, hydrocarbons, such as naphthalene, and, in some cases, of cyanides, the latter in concentrations which were found to be lethal to smolts under experimental conditions.

The distribution of the various toxic substances in the estuary of the Tees depends, says the Report, not only on the rate at which they are discharged and carried out towards the sea, but also on the rate at which they are broken down by bacterial or chemical action in the water. The course of this decomposition is being studied by chemical methods and experiments are being made on the rate of decrease of toxicity towards trout of various effluents and constituents when diluted with estuary water and stored.

In the upper reaches of the Tees a large volume of sewage enters the river at Croft, but for about 20 miles below that point there is no considerable source of pollution. This is, therefore, a convenient stretch of water for studying the breakdown of the sewage in the river. It has been found that temperature is the important factor. In summer the river purifies itself more rapidly and completely than it does in winter. In fact, in summer the river is practically pure at Eryholme, about 6 miles from Croft, while in winter the self-purification may not be complete before the industrially polluted zone is reached.

INDUSTRIAL EFFLUENTS.

Considering the disposal of polluting effluents from any particular industry, the Board points out that "the first logical step is to ascertain whether it is practicable so to modify manufacturing processes that no polluting effluents need be discharged. In some cases it may be possible by simple treatment to render the wastes fit for re-use in the factory operations, and the polluting character of the effluents may be reduced by the recovery of products of value." As a means of reducing the pollution caused by beet sugar factories, for example, suggestions have been communicated to the industry for the re-use of waters in that way, and they have been adopted at a number of factories. The Report states that several authorities in the industry have expressed the opinion, as a result of experience, that, in addition to avoiding pollution, the costs of making the necessary modifications for the re-use of part of the water are at least counterbalanced by the resulting economies.

Where the discharge of beet sugar effluents is unavoidable for various reasons, it has been definitely shown by the Board's work, and confirmed in practice, that a degree of purification of the order of 90 per cent. can be obtained for the press waters, the most polluting of the effluents, by a process of biological oxidation on filters.

The fauna and flora of the filters used have been allowed to develop naturally from the organisms present in the effluents or supplied from the atmosphere. Over eight hundred pure cultures of bacteria have been isolated from the filters, and laboratory experiments are now in progress to discover whether, by inoculating the filters with specially active organisms selected from these cultures, the rate of purification can be increased and the time required for the maturing of a filter at the beginning of a beet sugar season decreased. Information of value in considering methods of purification for other types of waste waters is also likely to arise from this work.

The Report further states that it is now recognised that the setting up of manufactories in areas not previously industrialised—such as has taken place since the war—need not be accompanied by the gross contamination of rivers which was a feature of the growth of industry and population in the nineteenth century, especially in the North of England.

WATER SOFTENING.

For many industrial processes soft water is essential, and experiments are being carried out on behalf of the Board at the Department's Chemical Research Laboratory on what is known as the base-exchange method of water softening. In that process the hard water is passed through a bed composed of certain sodium alumino silicates, and the calcium and magnesium in the water which produce the hardness are removed and replaced by sodium. When the water is no longer effectively softened the material of the bed is regenerated with salt. Various minerals and synthetic products suitable for the process have been tested and experimented with. It has also been shown that, when convenient, sea water can be used for the regeneration of the material. Another interesting fact is that traces of metal impurities in the water, such as lead, zinc, copper or tin, are removed by treatment with the base-exchange material.

NEW ARTESIAN WELL AT VIRGINIA WATER.

A SECOND and successful attempt has just been made to obtain a supply of water by means of an artesian well at the Holloway Sanatorium.

The work of drilling the well was entrusted to Messrs. LeGrand, Sutcliff and Gell, who found that it was necessary to drill to a depth of not less than 1416ft. in order to strike the water-bearing stratum, which was, in this particular instance, the lower greensand formation.

An overflowing supply of over 20,000 gallons per hour was obtained, the pressure of the water being 25 lb. to the square inch.

Analysis of the water proved it to be of excellent quality and suitable for all domestic purposes.

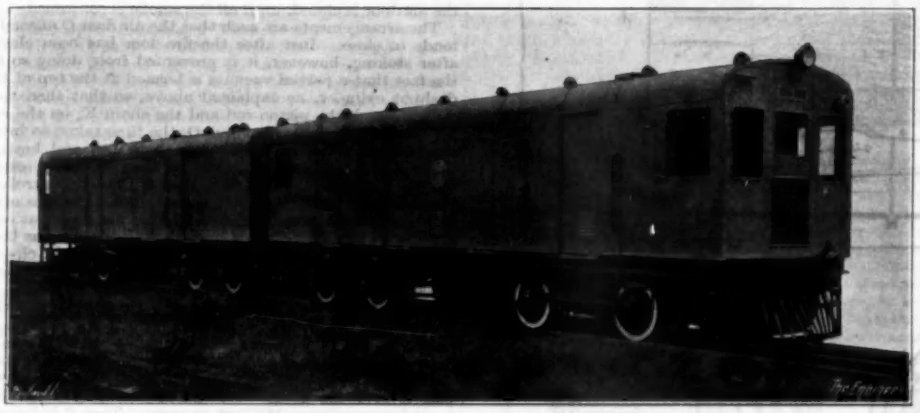
The succession of strata passed through was as follows:—

	ft.	in.		ft.	in.
Surface soil	5	0	..	5	0
Bagshot sands	21	0	..	26	0
Blue clay and claystones	376	0	..	402	0
Woolwich and Reading beds	41	0	..	443	0
Conglomerate and brown sand	2	6	..	445	6
Mottled clay	37	0	..	482	6
Green flints	0	6	..	483	0
Chalk flints	233	0	..	716	0
Middle chalk (?)	250	0	..	966	0
Lower chalk	173	0	..	1139	0
Upper greensand	25	0	..	1164	0
Gault and nodules	215	0	..	1379	0
Lower greensand	37	7	..	1416	7

The bore-hole is lined from top to bottom with 7¼in. steel tubing, so arranged that the water can flow up the bore-hole, but the sand is kept back.

Rolling Stock for the Bermuda Railway.

IN the issues of THE ENGINEER for September 25th and October 2nd last year we described fully and illustrated a petrol engine driven rail coach and trailer for the new Bermuda Railway. These coaches were built by the Drewry Car Company, and we are now able to illustrate in the engraving a steel freight van and trailer van constructed by the same firm for the railway and recently dispatched. It will be remembered that the coaches are driven by a Parsons petrol engine through Wilson-Drewry epicyclic pre-selective gearing. As regards the situation of the engine and the arrangement of the controls, the



PETROL ENGINE-DRIVEN FREIGHT VAN AND TRAILER FOR THE BERMUDA RAILWAY

interior of the leading end of the power freight van has much the same appearance as that of the power coach. The particularly good look-out for the driver should be noted. The Bermuda Railway has now been opened, and the Drewry Car Company, Ltd., states that it has received very satisfactory reports upon the performance of the vehicles supplied.

A Magnetic Moulder.

THE use of electricity as a direct power medium for moulding machinery was, we believe, first applied successfully in the squeeze machines patented and built by British Insulated Cables, Ltd., Prescot, Lancs., and described in our issue of February 13th last in connection with the British Industries Fair.

Previous attempts in the electrification of moulding machines always included a motor as a component part, and of such designs probably the original Pneulec machine is the most notable success. This machine is a combina-

MAGNETIC MOULDING MACHINE

tion of electric and pneumatic drive, but the Pneulec magnetic moulder has no motor attachment.

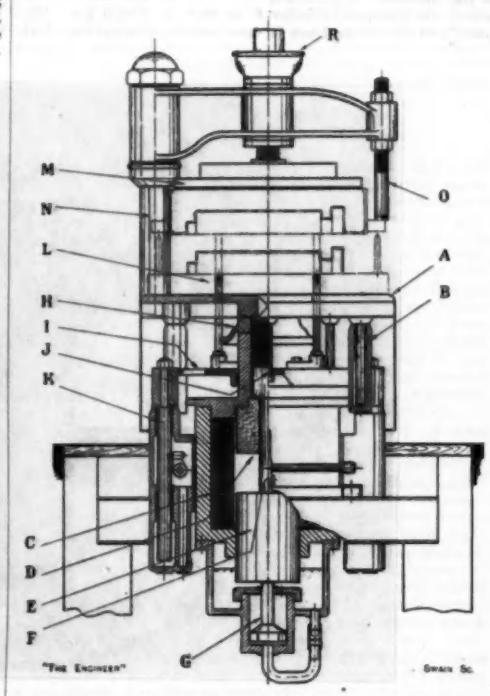
The makers, Pneulec Ltd., of Mafeking-road, Smethwick, indicate the following advantages of an electrically-operated machine. First and foremost is the fact that every machine is a complete unit, and requires neither compressor nor hydraulic plant for its working. Secondly, the construction of the machine itself is simple. There are no valves, glands, packings, &c., and there are no pits, pipe lines or elaborate foundations, or, in other words, all the disadvantages of air and hydraulic operation are obviated The simplicity of construction and installation, together with low power consumption, are perhaps the most important advantages of the magnetic machine.

Power costs are actually so low as to appear almost ridiculous. Where machines of types SS. 324, 486, and 640 are operated to produce moulds at the rate of thirty per hour, the total electricity charge for an eight-hour production is 1·533d. Bigger machines, such as the SS. 960 and 1280 cost 3·066d. in power, when operating under the same conditions, and with electricity charged at 1d. per unit. The type numbers of the machines quoted are intended to indicate in square inches the maximum box area the machine will squeeze, so that the SS. 486, for instance, will take a box up to 27in. by 18in., or its equivalent in area.

Reference to the sectional drawing and following description will show that with a magnetic machine power is consumed only during the actual squeeze, which takes one to two seconds. The pattern draw is by gravity on the down stroke.

The pattern table A is slotted for the attachment of the pattern plate, and is also provided with four slots for the stripping pins to come up through. There is a mild steel apron fixed to the pattern table, which prevents any sand getting into and accumulating on the top of the stripping frame and magnet pot. The outline of the machine is clean, and there are no ledges to cause sand to build up. There are four guide rods B, one in each corner. The rods are guided in brackets cast in the top of the magnet pot, and they have 6in. in bearing when at the top of the stroke.

The solenoid C, which effects the upward movement of the table, can be made in one or more sections, according to the length of movement required, and convenience in production. The electric current magnetically energises the stationary and moving cores D and E. The moving core E is consequently attracted to the stationary core D, and pushes up the pattern table through the medium of the rod F, which is made of Vickers P M G non-magnetic material. The cores are made of mild steel. The speed of movement of the pattern table is controlled by a dashpot arrangement G. The length of stroke is determined by the distance between the moving and fixed cores, which can be varied by raising or lowering the initial



SECTIONAL VIEW OF THE MAGNETIC MOULDER

position of the moving core and pattern table by means of the hand wheel H. In its upward movement the pattern table also raises the stripping frame I, which is attached to it by the lifting rods J. The stripping frame is guided in its vertical movement by two side rods K, which work in brackets cast on the side of the magnet pot. These rods have oil dashpots which cushion the downward movement of the stripping frame when released. When at the top of the stroke an automatic dog catch engages with a slot in the rods K, which hold the stripping frame and moulding box by means of pins L in the top position. Immediately following this action, the pattern table falls, carrying with it the pattern, which is thus withdrawn from the mould by gravity on the down stroke. The fall of the pattern table is controlled for speed by the oil dashpot G. After the mould has been removed the stripping frame is returned to the normal position by the release of the dog catch through the operation of a handle at the front of the machine.

Before starting the squeeze operation a loose filling frame is placed around the top of the moulding box to accommodate the extra depth of sand to be superimposed on the top of the box to allow for compression of the sand. The squeeze action causes the pressure head M to enter the filling frame, and press the additional amount of sand into the mould, thus giving the density required for casting. For convenience when filling the mould with sand, and again when the finished mould is to be removed, the squeeze head M can be swung around the supporting column N and placed to the rear of the machine. The pivot for this motion has a ball thrust bearing. During the actual squeeze the head is supported by an outer strain rod O. At the bottom of this rod there is a fixed collar which engages beneath a projecting jaw cast integral with the magnet pot and base of the machine. It will be noted that in order to accommodate boxes of different depths, the height of the pressure head may be adjusted by means of a screw, actuated by a hand wheel R.

We understand that three different type machines will be demonstrated at the 1932 British Industries Fair—squeeze strip, Downsand frame squeeze stripping plate, and a new rollover squeeze strip.

INSTITUTION OF MECHANICAL ENGINEERS: CANADIAN SUMMER MEETING, 1932.

THE Committee making arrangements for the Canadian Summer Meeting of the Institution of Mechanical Engineers is endeavouring to keep down the expense as much as possible in order to encourage a large attendance. As it is hoped that a large number of ladies will accompany the members, care has been taken to arrange a programme that could be undertaken without undue fatigue. Night travelling in America has been avoided, except on the journey from Ottawa to Toronto. According to the programme, which has been tentatively arranged, the party will leave Southampton on Friday, August 19th, on the Canadian Pacific liner "Montcalm," and will arrive at Quebec on Saturday, August 27th. After spending four hours in the city, the party will proceed by the "Montcalm" to Montreal, at which city it will stay during Sunday and Monday, August 28th and 29th. On the 30th it will be in Ottawa, and from August 31st to September 2nd it will be in Toronto and its neighbourhood. On Saturday, September 3rd, it will proceed by road to Niagara, and on the 4th and 5th it will be at the Falls. On September 6th it will go to Rochester and proceed thence to Albany. On Wednesday, the 7th, it will either go to Schenectady and thence by train to New York, or it will sail down the Hudson River to the same destination. Thursday and Friday, September 8th and 9th, will be spent in New York, and on the second of these days the party will embark on a Cunard liner of the "Scythia" class. It will arrive at Plymouth on Saturday, September 17th, and at London on September 18th. Arrangements would be made to suit the wishes of any members of the party who might desire to depart from the official tour, or to extend their stay in America. The cost of the trip with the pound at parity would be cabin £94, and tourist £76; but at the present rate of exchange these costs would be about £110 and £89 respectively. These prices include first-class travelling and hotels in America and all meals, and are, in fact, inclusive except for wines and for gratuities on the ships. Any suggestions with regard to the programme will be carefully considered.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

ROAD MATERIALS.

Granite and Whinstone Kerbs, Channels, Quadrants and Setts, No. 435.—The initial draft of this specification was drawn up by the National Federation of Granite and Roadstone Quarry Owners, and continual assistance was afforded by that organisation throughout the work. It is hoped that its general adoption by highway engineers will do much to further the economical production of kerb in this country by enabling the quarries to concentrate upon certain defined sizes and finishes. Three alternative standard dressings are provided, it being considered that this number should be adequate for the general demands of highway engineers; the standard sections of kerb comprise a series ranging from 4in. by 9in. to 8in. by 12in., with eight standard sizes of setts.

Asphaltic Bitumen Road Emulsion, No. 433, *and Cold Asphalt Macadam, No.* 434.—These two other road specifications form the first of a series dealing with emulsions and cold asphalt surfacing, and are based upon drafts prepared by the Road Emulsions and Cold Bituminous Roads Association. The first provides for an emulsion suitable for penetration (grouting and semi-grouting) and for surface dressing. It incorporates a specification for the asphaltic bitumen to be used, together with requirements for the essential properties of the resulting emulsion. Appendices to the specifications set out in detail the manner of conducting the various tests required to ascertain the specified properties.

The specification for Cold Asphalt Macadam prescribes the method of constructing this form of road surfacing by penetration, using the asphaltic bitumen road emulsions dealt with in the specification mentioned above. In form it follows the B.S.S. Nos. 342–348 for asphalt road surfacing by the hot process, published in 1928, and defines the nature of the aggregate, the method of laying and the manner of applying the emulsion. In an appendix are given examples of suitable gradings of aggregates and rates of application of emulsion and blinding material.

The "Flamma" Smoke Consumer.

A DEVICE for destroying the smoke produced in boiler furnaces has recently been put upon the market by Messrs. Hartley, Sons and Co., of Kearsley Chambers, Stoke-on-Trent. It is known as the "Flamma," and it depends for its action on the admission, for an adjustable period of time, of a restricted amount of heated air to the gases of combustion just after they pass from the rear of the furnace, the result being, it is claimed, that all the smoke is ignited to produce a bright and heat-giving flame.

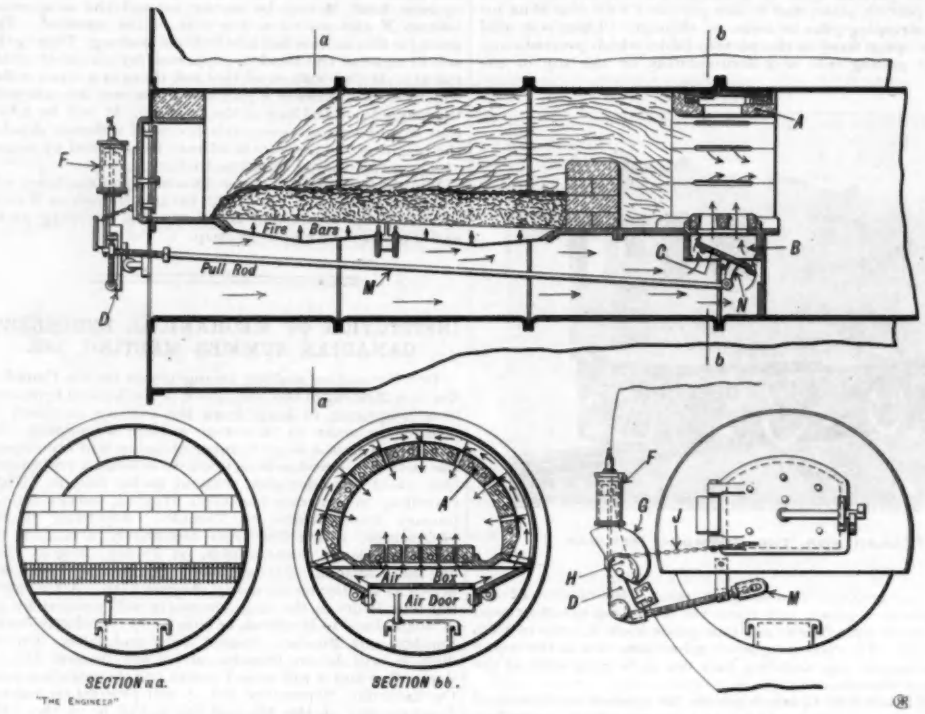


FIG. 1—ARRANGEMENT OF "FLAMMA" SMOKE CONSUMER IN A BOILER

The arrangement is illustrated in the accompanying illustrations. It will be observed that, at the rear of the furnace bridge there is what the makers term a regenerator A—see the section through *b b* in Fig. 1—which consists of a semi-circular arch of highly refractory fire-clay brick, with a flat horizontal floor, of the same material, arranged just below its centre line. The bricks of both arch and floor are perforated in a number of places, and they are supported in such a manner that they are free to expand and contract without crushing, so that their lives may be of long duration. In addition, they are reinforced by steel bars, so that, even if they become cracked, they may not fall away. We are informed that any one arch brick may be withdrawn from the arch independently and replaced without the necessity of removing any other brick.

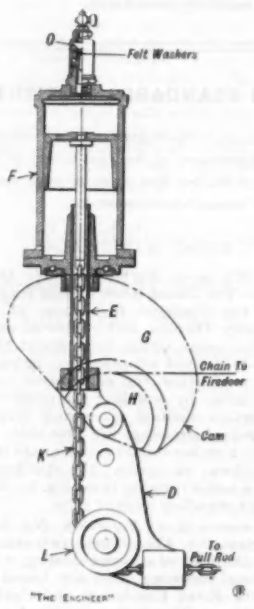


FIG. 2—OPERATING MECHANISM

Immediately below the floor of this regenerator there is an air box B, the bottom of which is normally closed by a door C. This door, which can be rocked on a pivot arranged at the centre of its underside so that it can be opened or closed, is controlled in the following manner:—Bolted to and projecting from the edge of the front of the boiler is a cast iron bracket D—Figs. 1 and 2—which serves several purposes. To its top is screwed vertically a steel tube E up and down the outside of which may slide an air dashpot cylinder F, the duty of which will be explained later. Pivoted to the bracket D is also a cam G, to the side of which is attached—so that both move as one piece—a grooved quadrant H. A chain J is fastened at one end to this quadrant, the other end being secured to the hinged side of the furnace fire-door. The underside of the dashpot cylinder F rides upon the edge of the cam G, so that when the latter revolves in one direction, the cylinder is raised, and when it revolves in the other direction the cylinder falls by its own weight, its underside always keeping in contact with the cam. Working in the cylinder F is a piston, the rod of which is free to move up and down in the tube E. Attached to the lower end of the piston-rod is a chain K which passes over a grooved pulley L, which, in turn, can rock on a stud on the bracket D, its other end being secured to one end of a pull rod M. This rod passes under the furnace of the boiler and its other end is pivoted to a lug N depending from the underside of the air door C.

We can now describe the operation of the device. Ordinarily, when stoking is not proceeding, the fire-door is, of course, closed—as shown on the left-hand side in Fig. 3—and so also is the air door C at the underside of the air-box B. In that position the chain J, attached to the fire-door, is taut and has revolved the cam G and raised the dashpot cylinder F as high as it will go. The lower end of the dashpot is open to the atmosphere, but the upper end is closed by a cover into which is screwed an air admission valve O. When the fire-door is opened for stoking, the pull on the chain J is released so that the quadrant H, and with it the cam G, are free to revolve under the action of gravity, with the result that the dashpot cylinder F, which, it will be remembered, rides on the cam—is lowered; the air door C remains closed. When the furnace door is closed again, the chain J is again tightened, so that the cam is partially revolved and the cylinder is raised. That causes a pull on the chain K and rod M, with the result that the air door C is opened. Before going on to describe the effect of that operation, it may be explained that the pull on the chain K and hence on the piston-rod and piston, causes the latter to move downwards in the dashpot and set up a partial vacuum on the upper side of the piston. The air valve O is adjustable, so that the amount of air entering the cylinder in a given time, and hence the rate of rise of the piston brought about by the pressure of the atmosphere acting on its underside, can be controlled.

The result of opening the air door C is that a certain amount of air, which in passing beneath the grate has become heated, enters the air box B and is drawn upwards into the spaces beneath the floor of the regenerator A and outside its semi-circular refractory arch. Passing through the perforations in the brickwork of floor and arch, the already partially heated air becomes much more strongly heated, and in that condition it meets and mingles with the gases of combustion and volatile hydro-carbons coming from the furnace. The result is said to be that there is instant and complete combustion of both gases and smoke, and that a bright heating flame, which is entirely smokeless, is produced. The flame, it is stated, continues, even when the air door is closed, until all the smoke is consumed.

The arrangements are such that the air door C normally tends to close. Just after the fire-door has been closed after stoking, however, it is prevented from doing so by the fact that a partial vacuum is formed at the top of the dashpot cylinder, as explained above, so that there is a pull, through the piston-rod and the chain K, on the rod M. By means of the air valve O, the time taken to bring about equilibrium of pressure on both top and bottom faces of the dashpot piston, so that the latter may return to its normal position, can be accurately controlled. Hence, the time during which the air door C remains open can be controlled, as may be desired, to meet various conditions. The control, when once the air valve O has been adjusted, is entirely automatic, the opening and closing of the fire-door being all that is necessary to bring about the necessary motions.

A number of claims are made by the makers for this device. For example, it is claimed for the "Flamma" (*a*) that it is the only smoke consumer which actually surrounds the smoke and gases coming from a boiler furnace and mixes them with heated air immediately they have passed over the bridge and automatically cuts off that heated air supply at the best moment. Then it is claimed (*b*) that it is the only really automatic smoke consumer which does its work without any attention from the fireman; (*c*) that it obviates the use of wasteful steam blowers and the time and trouble of operating them; (*d*) that it prevents soot from being deposited on the boiler plates exposed in the flues, and reduces the amount of fine dust deposited in the flues; and (*e*) that it saves fuel to the extent of some 15 per cent., quickly more than making up the cost of installing it.

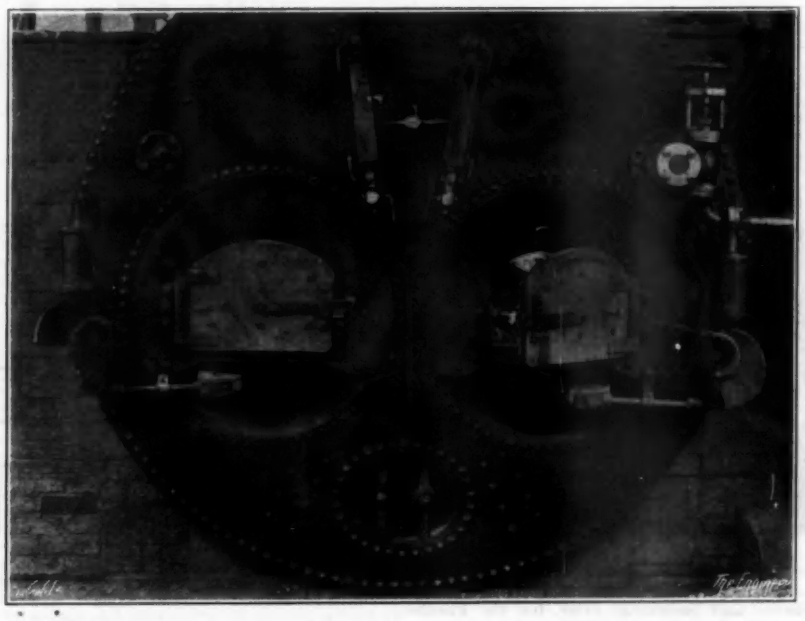


FIG. 3—FIRE-DOORS OF BOILER EQUIPPED WITH "FLAMMA" SMOKE CONSUMER

EXHIBITION OF BITUMEN CEMENT AND TIMBER IN INDIA.

AN exhibition and demonstrations designed to show some of the latest types of machinery, processes and applications used in connection with, and suitable for, bitumen, cement and timber were recently given to the members of the Bombay Engineering Congress. The show was arranged by Millars' Timber and Trading Company, Ltd., in conjunction with the Burmah-Shell Oil Distributing and Storage Company, Ltd.; the Consolidated Pneumatic Tool Company, Ltd.; John Fleming and Co., Ltd.; the Concrete Association of India; J. C. Gammon, Ltd.; and the Asphalt Products Company. The exhibition was divided into five sections:—I., Asphalt Roadmaking and other Uses of Bitumen in India; II., Concrete Machinery and Processes; III., Pneumatic and other Tools for P.W.D. and other Engineers and Contractors; IV., Pumps and Pumping Sets; and V., Timber.

In the first section the Burmah-Shell Company gave a demonstration in connection with actual roadmaking by the "Shellmac" process, in which sun-dried aggregate was coated with asphalt in a Millars' mixer and laid direct on a road, it being claimed that a first-class roadway could be thus produced at a less cost than that of an ordinary full-grout road without the use of expensive plant. In this section, too, there were various other exhibits of bituminous materials, including "Flintkote,"

by the Burmah-Shell Company, and various types of mastic by the Asphalt Products Company.

In the second section the Millars' Company showed a variety of its standard concrete mixing machinery as used in India, other exhibits including a concrete placing pump by John Fleming and Co., Ltd., and hollow concrete flooring, reinforced concrete poles and its "Tricosal" products by Messrs. Gammon.

The third section was devoted to an extensive display of pneumatic tools of all types, and of a cement gun and spray painting machinery, the latter being shown by John Fleming and Co. In Section IV. were seen various types of pumping machinery, the Millars' Company having on view a range of pumps with outputs varying from 75,000 gallons per hour, while one pumping set—exhibited by H. L. Rochat and Co.—was to be seen working with over 27ft. suction lift without a foot valve and without the necessity of priming.

In Section V. the Millars' Company displayed about forty varieties of Indian and Burmese timbers, particular attention being paid to timbers other than teak and to the types of work in which they could be profitably employed.

During the exhibition the Indian Roads and Transport Development Association showed a series of films illustrative of different types of road construction, entitled:—(1) "Road Building with Graders in India," "Low Cost Road Construction in America," and "Concrete Road Construction in America."

The exhibition and demonstrations are described as being great successes and it is anticipated that they will, in future, be repeated annually.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MAJOR RICHARD MILES has been appointed a local director of Newton, Chambers and Co., Ltd., of Thorncliffe Ironworks and Collieries, near Sheffield.

RICHARD A. WHEATLEY (1931), Ltd., asks us to announce that it has removed from 11, Brownlow-mews, W.C. 1, to Brook-road, Wood Green, London, N. 22. New telephone number: Mountview 6337.

THE WADLEY MANUFACTURING COMPANY, Ltd., 4, South-place, Moorgate, E.C. 2, informs us that it has removed its city offices from that address to its works at 25, Hackney-road, London, E. 2 (telephone No., Bishopsgate 1533).

MR. H. C. AMOS, M.I. Mech. E., of 22, Martin-lane, Cannon-street, London, E.C. 4, asks us to announce that he has been appointed by Messrs. Graham and Normanton, Halifax, makers of lathes and shaping machines, as their London representative.

WE are asked to announce that Addressograph, Ltd., and the International Multigraph Company (Britain), Ltd., of 73–78, High Holborn, W.C. 1, which have for a considerable time been working in very close association, have now amalgamated, and that the title of the combined company is Addressograph-Multigraph, Ltd. Its general sales offices and showrooms will be at 73–78, High Holborn, W.C. 1, and the Addressograph sales division is being removed from 29, Kingsway, to that address. It is requested that all post and telephone orders for supplies and repairs should continue to be sent to the factory at Willesden Green (telephone, Willesden 6333–4–5–6).

CALENDARS, DIARIES, &c.

ASHWELL AND NESBIT, Ltd., Barkby-lane, Leicester.—Wall calendar with daily tear-off slips.

Chemical Trade Journal and Chemical Engineer, 265 Strand, W.C. 2.—Wall calendar with monthly tear-off sheets.

DARIEN PRESS, 5, 6a, and 7, Bristo-place, Edinburgh.—Calendar with monthly tear-off sheets.

HARLAND AND WOLFF, Ltd., Belfast.—Wall calendar with monthly tear-off sheets.

LUDGER GRAVEL AND FILS, Limités, 426, Place Jacques-Cartier, Montreal.—Wall calendar with monthly tear-off sheets.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester.—Wall calendar with daily tear-off slips.

WELBECSON PRESS, Ltd., Blenheim House, W. 11.—Wall calendar with monthly tear-off sheets.

CONTRACTS.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received an order from the Metropolitan-Cammell, Carriage, Wagon and Finance Company, Ltd., for the brake sets required for sixty all-steel, 40-ton wagons for the Tientsin-Pukow Railway.

LEIPZIG FAIR.—In view of the present difficult economic conditions all over the world, the Engineering and Building Section of the Leipzig Fair will be held from March 6th to 13th only, and not from March 6th to 16th, as originally notified.

LECTURES ON MACHINE TOOLS.—Alfred Herbert, Ltd., of Coventry, informs us that it has arranged a demonstration of modern machine tools at its Birmingham showroom, 208, Corporation-street, on January 25th to February 5th inclusive. In conjunction with the demonstration, Mr. R. C. Fenton will deliver lectures on machine tool developments on January 28th, February 2nd, and February 4th, at the Central Hall, 196, Corporation-street. The lectures will cover the use of tungsten carbide tools, the application of motor drives and improvements in driving and feeding mechanisms, and will be followed by discussions. On February 3rd, Mr. A. A. Gigli will give a lecture on "Fine Tools and Optical Instruments." Invitations to attend the demonstration and lectures are extended to all interested.

BRITISH ROAD MAKING.—"British Road Making—Past and Present" is the title of a readable little booklet, written by "Hermes," and published by Johnson, Clapham and Morris, Ltd., of Newton Heath, near Manchester. The means of intercommunication between different places of this country at different periods of history are reviewed from the mere tracks of prehistoric times, down through the period of Roman occupation, when large blocks of stone were used to form the solid foundations of long undeviating causeways; then, during the centuries of neglect when those magnificent arteries of traffic were allowed to fall into utter ruin and were even robbed of their foundation stones for building houses; the dawning of a slightly better era in the time of Queen Elizabeth; the improvements wrought by blind Metcalf, Telford and McAdam; the days of the stage coach: the introduction of the concrete bed, and, finally, of the reinforced roadway. All the story is told in an attractively simple manner, and we have had great pleasure in reading it.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

THE week has brought no change to the industrial situation in the Midlands and Staffordshire, neither did last week's quarterly gathering of industrialists in Birmingham add anything material to iron and steel producers' order books. Uncertainty as to what is ahead of the iron and steel industry is having a disturbing influence and initiative has been temporarily abandoned. The heavy industries in this area show no definite trend towards a real recovery, progress being restricted to the lighter trades. The call for iron and steel is disappointing and market activity is limited more or less to hand-to-mouth transactions. Values are hardly tested by the small volume of business available and quotations remain unchanged from last week.

Pig Iron.

The enhanced demand for Midland brands of pig iron is sustained, though it has failed to grow, chiefly because work is so limited at the heavy foundries. The steady demand which has been coming from the light castings trade of late is the encouraging factor in the raw iron situation, for it not only enables pig iron producers to dispose of their production, but, in some cases, enables them to withdraw some material from stock. Moreover, prospects of a continuance of healthy conditions in that branch of trade are held to be bright. Unfortunately, unless there is a great change in the outlook, the consumption of pig iron in the heavy foundries is not likely to increase much this quarter. Of course, the prospective demand for pig iron, like other materials, depends very much upon developments which, in some quarters, are considered to be daily growing closer. There is no chance of stringency in the pig iron market. There are considerable accumulations of stock and, moreover, blast-furnaces are capable of supplying all the raw material the consuming industries are likely to call for. There is ample plant which can be commissioned if the necessity arises. At date, foundries are taking delivery of material at about the same rate as at the opening of the quarter. The light casting foundries are taking satisfactory tonnages, but the engineering foundries are absorbing very little. Consumption at the forges is very unsteady, and the market for that grade of iron has been decidedly flat for many months past. The scale of selling prices as fixed by the Central Pig Iron Producers' Association remains unchanged. Northamptonshire No. 3 foundry is £3 2s. 6d., forge £2 17s. 6d., Derbyshire and North Staffordshire foundry is £3 6s. and forge £3 1s. Blast-furnace coke is now quoted about 12s. 6d. per ton, and there appear to be ample supplies available.

Blast-furnace Blown Out.

Partly as a result of depression in trade and partly because the furnace is very old, Alfred Hickman, Ltd.—a branch of Stewart and Lloyds—has this week blown out one of its blast-furnaces at Springvale Ironworks, Bilston, Staffordshire. Recently, there were three furnaces in operation, but there are now but two. About fifty men are directly affected by the taking out of commission of this furnace.

Steel.

There is no appreciable change in the steel situation. The stagnant conditions ruling in the heavy engineering industries are reflected in poor specifications for finished steel. Demands are limited to small tonnages, which means intermittent working in the rolling mills and the frequent changing of rolls to produce a few tons of steel in a variety of sizes. The constructional engineering business has seldom been worse than it is to-day, judging by the experience of Black Country firms. Structural work is being given out very sparingly, and keen competition and the anxiety to find work for the yards keeps prices on an unremunerative basis. There is still a brisk demand for cold-rolled steel and other special qualities, which, till recently, were largely imported. Quotations for heavy steel were reaffirmed at the end of last year, and the basis rates have not changed. Angles cost £8 7s. 6d., joists £8 15s., and ship, bridge and tank plates £8 17s. 6d., all these quotations being subject to the usual rebate to those who agree to take British steel only. Business remains about the same in the semi-finished department. If anything re-rollers are less active than they were, users having satisfied their immediate requirements. Values are substantially unchanged. Small steel bars, all-British, are quoted £7 5s. upwards, re-rolled bars are £6 12s. 6d. upwards, mild steel billets £5 7s. 6d. to £5 10s., sheet bars £5 5s., and Staffordshire hoops £9 10s. Local merchants are not selling much Continental iron and steel, though there have been fairly bulky deliveries in the last few weeks. The main obstacle to business is the existence of heavy stocks at the works, which usually buy foreign material.

Finished Iron.

Staffordshire ironmasters derived little, if any, benefit from last week's quarterly gathering of buyers and sellers. Though the attendance was large and conversations animated, the business given out was, as far as ironmasters, at any rate, were concerned, negligible. Hopes had been entertained of improved buying of best grade bars by the engineering industries, but so unsettled is the whole outlook that consumers exercise the greatest caution and make purchases only as material is required for use. Looking around the works in Staffordshire this week reveals little of an encouraging nature. There is no steady flow of orders in any branch, and the difficulties of maintaining operations at the works are great. Even the strip mills, which have had a fairly good run of business, are now feeling the pinch, and makers would be glad of the smallest specifications. What new business is transacted is mostly put through at the minimum quotation of £10 10s., though £10 12s. 6d. continues to be quoted in some quarters. The price of marked iron is unchanged at £12 a ton at makers' works, and Crown iron varies from £9 5s. to £10 per ton. Nut and bolt and fencing bars continue to be named £8 7s. 6d. without finding purchasers.

Galvanised Sheets.

Conditions are slow in the galvanised sheet trade. The record of shipments in 1931 shows a big decrease on the previous year, and there seems to be no immediate prospect of recovery. Orders from overseas are mostly for relatively small tonnages, and competition for the work available is very keen, which accounts for the instability of quotations. At last week's quarterly meeting of the iron trade in Birmingham there was an improvement in buying of sheets on home account, and conversations amongst producers and consumers led the former to anticipate progressive orders from this quarter as the year advances. It is upon the export trade, however, that the sheet industry mainly depends for its prosperity, and while the betterment of the home trade is welcome, it will not place mills in a sound position. A resumption of active buying on the part of overseas users of sheets would delight Midland producers, whose mills are far from fully employed. Selling prices continue round about the basis of £9 per ton for 24-gauge galvanised corrugateds. Quotations, especially for the home trade, are generally half-a-crown per ton above this figure; but, on the other hand, for substantial orders for shipment something less than £9 would probably be taken by many millowners. Efforts to strengthen selling prices meet with no success.

Mr. Hore-Belisha's Visit.

Mr. Hore-Belisha, in his search for information as to conditions in the iron and steel and allied industries last week end, made a tour of Black Country works. Not only so, but he was given the opportunity of meeting local industrialists' supporters of and opponents to tariffs, so that he became more fully acquainted with each angle of opinion. Speaking at one of the several gatherings of industrialists, Mr. Hore-Belisha made the following interesting observations: "I find the industry full of hope and energy with a keen scientific spirit, and one of the features which particularly strikes me is that it is quite rare to meet any responsible official who has not studied the counterparts of his industry in foreign countries. I have met an extraordinarily alert body of directors and officials who are most anxious to give one complete access to all facts at their disposal. We have here some of the finest plants in the world, and it is most inspiring to see all this modern machinery working so smoothly under such fine healthy conditions."

Edge Tools.

The trade depression has been so marked in the heavy edge tool industry in the Midlands that it is with some satisfaction I am able to report this week some slight progress towards recovery. The industry is responding slowly to the new situation created by the exchange rates. Considering the depletion of stocks in the plantations, as the outcome of restricted buying in the last few years, however, the present volume of orders remains rather small. Local works are better employed, though staffs are still terribly depleted. Manufacturers, however, entertain hopes of a general improvement in the course of the next few months. At date, there are few, if any, firms in this area which are satisfactorily situated, but business is not as dead as it was.

All-steel Wagons.

A very useful order, one for sixty all-steel wagons, has just been received by the Metropolitan-Cammell Carriage, Wagon and Finance Company, of Birmingham. The wagons, which are required for service on the Tientsin-Pukow Railway, were ordered by the Chinese Purchasing Commission.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Sombre Picture.

THE report of the Engineering and Metals Section of the Manchester Chamber of Commerce for the past year, to quote its own words, "does not present a very optimistic picture, although there are brighter spots in the remarks on one or two branches of engineering." Trade in textile machinery, it is pointed out, has not been able to make much headway because of the smallness in demand, both at home and abroad. The Lancashire textile industry experienced another year of difficulties, and the immediate outlook is not encouraging. Some textile machinists have turned their manufacturing activities to other pursuits, such as the making of vacuum cleaners and small marine internal combustion engines. Generally speaking, conditions in machine tools have not improved by comparison with 1930, and there does not appear to be prospect of an early immediate improvement. Home trade is depressed, and purchases involving capital expenditure have been held up until there is a general improvement in trade. As far as the export market in machine tools is concerned, conditions are somewhat similar. There has not yet been any improvement in business abroad since this country went off the gold standard, and we have yet to see whether the advantages which are expected to accrue to British manufacturers will materialise. Unfortunately, advantages in our competitive position do not help when customers are unable to place orders, and that would appear to be the real explanation of the present position abroad to-day. The only active market for machine tools abroad is Russia, which has placed very substantial orders for machine tools in this country during 1931.

Electrical and Gas Engineering.

Electrical engineering appears to be one of the few bright spots referred to in the report of the engineering section. Firms in that branch are in the fortunate position of having a certain guarantee of activity resulting from the work under the Central Electricity Board. The general outlook is fairly hopeful, and a number of orders for heavy equipment have come to Manchester makers. Electrification schemes and the growing use of electricity in marine work have resulted in increased business for those engaged in the manufacture of motors, generators, and switchgear. Referring to conditions in the gas engineering branch, the report states that several new installations of carbonising plant have been brought into operation during the year, both at home and abroad, and of them, Manchester firms had their fair share. They include two very large plants in London, one in the Argentine, and one of the very smallest installations of vertical retorts at Stornaway in Lewis Island, Scotland. In the domestic market for gas the main feature of interest is the introduction of a new type of gas fire, which is absolutely silent, and which still further increases the efficiency of the use of gas in this field.

Locomotives.

Activity in the locomotive section of the industry has been very seriously affected by the depressed state of world trade. Very few contracts have materialised during the year, notwithstanding the anticipations in the early months. An improvement can only be hoped for when world economic conditions bring a more confident tone in international affairs. The unsettled state of world markets has caused schemes of development to be delayed, and the industry has had to be content with a very small share of normal working. Some orders for boilers for India were placed, due to the improved position in competition with the Continental makers, resulting from the advantage in exchange. These were small consolation, but they have enabled a certain amount of plant to be kept in a state of activity.

Personal.

At the annual meeting of the engineering and metals section of the Chamber on Friday of last week, Alderman F. J. West was re-elected Chairman, Mr. L. F. Massey Vice-chairman, and Mr. E. R. Brayshaw Hon. Secretary.

Non-ferrous Metals.

Reaction has been witnessed in all sections of the non-ferrous metals market during the past week, although, except in lead and spelter, a portion at least of the improvement registered in the previous week has been maintained. Buying interest from consumers of tin in this country, as well as on the Continent and in the United States, has been in evidence, and the "bullish" element among speculators has also not been idle. The result at one time was an advance in quotations to a higher level than had been experienced for more than eighteen months, but the rise was not maintained, and, compared with a week ago, there has been a loss on balance of nearly £2 a ton. A heavier decline, both actually and relatively, has been witnessed in the copper market, values at the moment of writing being about £3 10s. a ton lower for standard brands than they were at last report, although still somewhat higher than a fortnight ago. The demand for the metal has been of a fluctuating character, but at no time has it been at all encouraging. Business in lead has been rather quiet, and under the pressure of liquidating operations there has been a substantial decline on the week of 15s. a ton. Spelter, also, has been relatively slow, and, in sympathy with the other metals, has eased off to the extent of about 7s. 6d. a ton.

Iron and Steel.

Sentiment in the pig iron section of the Lancashire markets appears to have taken a depressing turn, owing chiefly to the continued unsatisfactory position of general foundries in the district, although reports are to the effect that the recent improvement in the light castings branch has been maintained, and that, on the whole, a little more iron is being taken by textile machinists. Prices are steady at 67s. per ton, delivered equal to Manchester, for Derbyshire, Staffordshire, and Cleveland brands, 65s. 6d. for Northants, about 87s. for Scottish, and 81s. for West Coast hematite. There is little business moving in manufactured iron, although values keep up on the basis of £9 15s. for Lancashire Crown bars, and about £8 5s. for seconds. The demand for steel from constructional engineers, boilermakers, and locomotive builders is very poor indeed, although a little more buying has been in evidence during the past few days in small bright drawing bars and in general plates. Small re-rolled bars are unchanged at about £7 per ton, but both new business and specifications against old contracts are very disappointing. Boiler plates are at about £8 15s. per ton; tank plates at £8 17s. 6d.; sections at £8 7s. 6d.; joists at £8 15s.; and large bars at £9 7s. 6d. There is no general buying in the Lancashire markets for imported products, and only strictly moderate tonnages have been involved in the few transactions that have been reported during the past week.

Institution of Electrical Engineers.

The annual dinner of the North-Western Centre of the Institution of Electrical Engineers, which was held at the Midland Hotel, Manchester, on Tuesday last, had the largest attendance which has ever been experienced. It was presided over by Mr. L. Romero, M.I.E.E., the Chairman of the Centre, and the guests included Mr. A. E. L. Chorlton, M.I. Mech. E., Dr. S. L. Pearce, Sir W. Noble, Mr. W. H. Moberley, D.S.O., Vice-Chancellor of the University, Manchester; Professor Dempster Smith, M.Sc. Tech., Chairman of the North-Western Branch of the Institution of Mechanical Engineers; and Mr. J. M. Donaldson, M.C., President of the Institution of Electrical Engineers. The toast of "The City and Trades of Manchester" was proposed by Mr. Moberley and responded to by the Deputy Mayor, Alderman Titt, who spoke of the efforts which were being made to attract new industries to the neighbourhood by the Manchester Development Committee. In this connection he mentioned the steps which are being taken to establish the food-canning industry on the new Wythenshawe Estate. The toast of "The Institution of Electrical Engineers" was proposed by Mr. B. Mouat Jones, D.S.O., Principal of the College of Technology, who excels in the art of after-dinner oratory, and on this occasion his speech was one of his very brightest. Mr. Donaldson replied and commended the efforts which are being made in Manchester towards co-operation on the part of the various engineering societies. Mr. Chorlton, in replying to the toast of "The Guests," said that the progress made by the electrical industry was due to the intensive and widespread technical training of electrical engineers, which was what the country needed to-day. What the Lancashire cotton industry needed, he added, was new machinery which would produce better fabrics, more quickly and cheaply than was the case at present. In that respect cotton manufacturers should copy the example set by the electrical industry. There was, too, much more need for research both by public bodies and private firms. On the whole the speeches were of a high standard, and the evening's proceedings reflected credit on those who were responsible for the arrangements.

BARROW-IN-FURNESS.

Hematite.

The slight improvement noted last week is maintained, and makers are selling a little more pig iron, and are receiving a few more inquiries; yet on the aggregate the tonnage is not heavy, and business may still be said to be of a very quiet order. Stocks exist and are still heavy. The general run of orders is for immediate requirements, and none of the deliveries bulks large. Continental business is very quiet, despite the reduced price, which obtains as a result of the value of the pound abroad. The same thing applies to America, which is still disinclined to buy West Coast hematite to stock. In the case of America, there is just the chance of its coming into the market, and if it does there should be a fair amount of business done. At present it has neither the confidence nor the money. Iron ore is in quiet demand, and there is not much being done at the local mines. Foreign ore is in easy demand, and shipments are reduced. The steel market is in a very moderate state. The Barrow rail mills will restart next week, and it is hoped that further orders will come to hand to help keep them going. There is a chance of business improving in certain classes of steel, as a result of English consumers finding foreign markets too dear now, but it is too early to say anything definite on that subject at present.

SHEFFIELD.

(From our own Correspondent.)

Trade Improvement Slow.

ALTHOUGH there is some improvement of conditions in certain sections of the local steel industry, most of the big works have not yet regained the position which existed before the holiday stoppage at the end of last year. Each week, a few more men are engaged, but still the activity is not so great as it was a few weeks ago. The improvement is very slow, and although a fair number of orders for lighter steel products is being obtained, there is still a lack of substantial tonnage business. At Parkgate, Ickles, Thorncliffe, and Staveley, trade is fairly good, but most of the Sheffield works are poorly occupied. There has been some falling off in stainless steel work, which in the past has been good, whilst other departments have been depressed, but to counteract that tendency more work is being obtained in connection with tool steel and strip.

Russian Trade Prospects.

One or two branches of the industry are benefiting from the present rates of exchange, and it is felt that, aided by the low value of the pound, this country will be able to supply to Russia many commodities much cheaper than foreign competitors are able to do. Many firms in Sheffield have just received from Arcos, Ltd.—the buying organisation of Russia—a questionnaire which asks for information relating to the nature of the productions, capacities of the works, number of persons employed, the status of the firms, &c. In view of the fact that several valuable Russian orders are on hand in Lincoln, Gainsborough and elsewhere in the district, it is hoped that these inquiries are a prelude to the placing of substantial orders in Sheffield.

Work for Flying Boat.

The news that the Air Ministry has decided to cease work on the giant monoplane flying boat, which was under construction at the Vickers Supermarine Aviation Works, Southampton, is not satisfactory for Sheffield, as considerable quantities of stainless steel have been sent from the Vickers works of the English Steel Corporation, Ltd., in Sheffield, to Southampton for use in the monoplane. The stainless steel was being used in the bodywork, whilst a lighter alloy was being extensively used in other parts. One or two Government orders have just been obtained by local firms. Gun-metal cocks, valves and torpedo fittings are to be supplied to the Admiralty by W. N. Baines and Co., Ltd., Rotherham, and the English Steel Corporation is to supply telegraph shafting.

Attracting New Industries.

As mentioned previously, great efforts are being made in Sheffield and surrounding areas to attract new industries. Sheffield's work in this direction has now been concentrated in one organisation headed by Major T. H. Howard, secretary of the Intelligence Department of the Sheffield Chamber of Commerce, whose services have been lent to the Sheffield Corporation for an experimental period of three months. Up to the present, a number of inquiries has been received and dealt with in the city, but nothing definite has developed. Similar work is being done at Hull and Goole, and among the inquiries received by the Hull Development Committee from foreign firms desirous of establishing works in this country is one from a Dutch firm which asks for information as to a site for chemical works to employ 300 persons. The Yorkshire Electrical Power Company has circularised foreign firms regarding available factory sites in the extensive area of Yorkshire, in which it supplies electricity.

German Firm's Cutlery Plans.

Great interest has been aroused in Sheffield by the announcement that a German firm has arranged to start a factory in London for the manufacture of cutlery. In addition to being anxious to learn why that plant is not to be situated in the Sheffield area, local manufacturers feel that the Government should take steps to prevent such branch factories being actually merely a means of evading import duties. It is hoped such a factory will not be allowed merely to assemble in this country German-made parts which are not taxed adequately, and may be invoiced to the English branch factory at far less than the proper costs of such parts if made of Sheffield steel and with 100 per cent. British labour. It is suggested that the recently formed Imports Committee of Sheffield Industries, supported by the Cutlers' Company, the Chamber of Commerce, and Sheffield Members of Parliament should insist that proper safeguards are imposed.

Leeds Works Activity.

At the Hunslet Steel Works of Walter Scott, Ltd., Leeds, a blast-furnace with a capacity of about 1000 tons per week has been restarted after being out of commission since last July, and a second is in course of preparation for blowing-in. The plant was closed down owing to the accumulation of stocks of pig iron, but they have now been reduced, and orders for foundry iron from Yorkshire and Lancashire foundries have warranted the restarting of the plant.

Railway Materials.

Departments concerned with the manufacture of railway materials, springs, tires, axles, &c., are extremely short of work. It is hoped that the British railway companies will shortly find it necessary to place substantial orders, and it is authoritatively stated that the L.M.S. Railway will require approximately 74,000 tons of British steel rails in connection with its normal programme of track maintenance for 1932. Exports of railway steel remain at the abnormally low level of previous months, and the trade in wagons and carriages has shrunk to very meagre proportions.

Overseas Trade Facts.

Interesting figures are now available with regard to exports during last year. Manufactured iron and steel exports during 1931 totalled 1,930,617 tons, valued at £30,410,000, and these figures may be compared with a tonnage of 3,159,681 and a value of £51,261,119 in 1930, and with 4,379,541 tons and £68,000,000 value in 1929. During last month there was a shrinkage of exports from 195,703 tons in November to 175,256 tons, this notwithstanding increased exports of tin-plate and galvanised sheets to Eastern markets.

The Lighter Trades.

Conditions in the cutlery and plate trades are, generally speaking, unchanged, but trade in files is a little brisker and prospects are regarded fairly optimistically, in view of the heavy duty on foreign files. The Indian Army authorities have invited tenders for 34,700 one-piece steel table knives, 21,400 unplated dessert spoons, and 25,000 unplated forks. The first order of a Paris firm, which has been granted a concession for the sole sale in France of the "Laurel" safety razor blades, manufactured by George H. Lawrence, Ltd., Sheffield, is for 5,000,000 blades, delivery to begin forthwith.

Yorkshire Bridges.

In the Cawood bridge, which carries the Cawood to York road over the river Ouse, there has been considerable movement of the sheet piling on the south side of the bridge, and a scheme for the carrying out of repairs is to be carried out, the cost to be borne jointly by the East and West Riding County Councils. Vehicles of 5 tons and over are being prohibited from the use of the Thorne Bridge on the Hull–Doncaster–Sheffield main road, whilst a new bridge is being constructed near the old one. The completion of the new bridge will mean that traffic will have an uninterrupted journey, as Thorne Toll Bar bridge can now carry the heaviest of traffic, and Boothferry bridge takes traffic across the Ouse.

NORTH OF ENGLAND.

(From our own Correspondent.)

Big Job for Teesside.

AN important engineering order, which will create a substantial volume of employment, has been secured for Teesside. Ashmore, Benson, Pease and Co., Ltd., of the Parkfield Works, Stockton, who have gained a great reputation for their patent Freyn blast-furnaces, have secured an order for the redesigning and building of a furnace for the British Iron and Steel (Guest, Keen and Baldwin), Ltd., at its Cardiff works. This furnace holds the record for output in this country. During a period in blast it averaged just over 500 tons per day, and for many consecutive days 600 tons. The principal feature of the rebuilding is the uncommon strength and ruggedness of the construction to be employed, which, together with the extensive means of cooling the stack, should go far towards securing longevity of the service. Ashmore, Benson, Pease and Co. are at present completing the construction of another new blast-furnace at the Ford factory at Dagenham.

Cleveland Iron Trade.

A more encouraging position is reported in the Cleveland pig iron trade. The demand has shown a marked improvement during the last few days, and deliveries are now in excess of the output, with the result that some inroads are being made into the stocks of iron, which had increased during the holiday period. Whilst disposal of the present make of pig iron seems now to be assured for a month or two ahead, the needs of the consuming industries are still too limited to justify any expansion of output, and there remain only seventeen blast-furnaces in operation on the North-East Coast. Much of the output continues to be absorbed by producers' own consuming departments, and sales are chiefly to home consumers, though buyers abroad are more disposed than of late to negotiate for supplies from this district. Prices are steady and unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

A slight improvement is reported in the demand for East Coast hematite pig iron, which is, if anything, easier in price, though producers protest that quotations are already well below cost. Second hands are keen sellers, and have fairly substantial parcels to offer. Customers state they can readily cover needs at a little below the basis of 65s. for ordinary qualities, but makers ask up to 6d. above that figure.

Iron-making Materials.

Nominally, best Rubio ore is 16s. 6d. c.i.f. Tees, but there is no local demand. The value of good medium blast-furnace coke is unchanged at 17s., delivered at the works.

Manufactured Iron and Steel Trade.

There are no new features on the various branches of the manufactured iron and steel trade. Departments turning out constructional steel have a good deal of work to execute, but orders for nearly all other descriptions of material are much needed. No price changes are reported.

Cleveland Miners' Wages.

The wages for the next quarter of the Cleveland ironstone miners and associated limestone quarry workers will continue on the same level as in the past three months. This decision was reached by the employers' and men's representatives this week. The ascertained price of pig iron for the past three months, upon which the sliding scale depends, showed only a very slight variation from that of the previous quarter, and it was agreed that wages should be left unaltered.

The Coal Trade.

Once more a quiet spell has come over the Northern coal market. It is due to a variety of causes—notably a continuance of the industrial depression at home and abroad, the mildness of the weather, import restrictions, and financial difficulties abroad, and the spurt in buying of a few weeks ago, which is leaving customers with sufficient supplies for the present. Inquiries have fallen away and very little new business is reported. For the next few days all anticipated output is earmarked and tonnage stemmed, but for the end of the month and forward the outlook is only fair, and there is a growing volume of supply on offer. Buyers can cover at recent lowest quoted prices, and some grades can be obtained at the schedule minimum. Best Northumberland steams for next week and onwards are offered direct at 13s. 9d., and Tyne primes according to date of loading at 13s. to 13s. 3d. For these brands there is a steady demand for the coal to be used for household purposes, but even in this trade the mild weather is slowing down requirements. Secondary steams, while fully steady for prompt, are plentifully offered forward at 12s. to 12s. 3d. Best steam smalls are again becoming difficult to dispose of, and stocks show signs of increasing. Prices are weak and 8s. 6d. is asked for any period of delivery. Wear prime steam are also moving slowly at 15s. and 12s. for large and small respectively. Favourite brands of bunker coal are still rather scarce, and any lots on offer are snapped up at full recent prices of 14s. 3d. to 14s. 9d., according to individual brands, but secondary bunkers are fairly plentiful at 13s. 3d. Durham gas coal is moving under contract demands, but surplus output is difficult to clear. Best qualities are quoted at 14s. 6d., and prime Wear qualities at 15s. Secondary gas are abundant at 13s. 6d. Durham coking unscreened move slowly, shippers being eager to get some definite news from France regarding the lifting of the surtax. Meantime, easy minimum prices are indicated, unscreened at 13s. to 13s. 9d. and small 12s. 6d. to 13s. 3d. The inquiry for gas coke remains steady, and supplies for the next week or two are scarce, 19s. being steadily asked. There is a good inquiry for coke nuts, production being fully booked up, with 19s. to 21s. 3d. asked for next month's shipments. Patent oven coke is quiet and plentiful at 16s. 6d. to 17s. 6d., and superior descriptions 18s. to 21s.

SCOTLAND.

(From our own Correspondent.)

Dull Markets.

IN the Scottish steel, iron, and coal trades, conditions remain unchanged. Since the beginning of this month inquiries have been a little more generous, but markets still lack definite improvement.

Steel.

The majority of the steel works are again in operation. Orders, however, have not accumulated to an extent sufficient to enable plants to work to anywhere near capacity. Specifications for ship plates and sections have not improved in the slightest, and prospects are not any better in this department. Steel sheets are better off than any other branch. Mills especially interested in thin sheets are well engaged, but heavy sheets are not securing a better share of the business being offered. Inquiries from the Near East and South America are particularly good, though the political situation in India is not reassuring. Galvanised sheets are securing a fair measure of support, but the prices obtainable are not particularly acceptable. Tubes cannot yet report a change for the better, and no market improvement is looked for in the near future.

Iron.

The recent reduction in the home price of bar iron has failed, as yet, to bring any response, and specifications are still very scarce. Re-rolled steel bars, also, are dull. The latter are quoted £6 5s. home and £6 2s. 6d. per ton export.

Pig Iron.

The number of furnaces in blast in Scotland is still five, and the output from them is more than sufficient to cover requirements. Though imports from the Continent are eliminated, meantime, cargoes still arrive from other sources, the latest consignment reaching the Clyde being one of 2250 tons from Calcutta. Shipments last week only amounted to 100 tons, 50 of which went abroad, compared with 461 tons (433 tons foreign) in the same week last year.

Scrap.

Prices of scrap remain firm and unchanged at 42s. 6d. for heavy steel and 57s. 6d. to 60s. per ton for cast iron machinery.

Unique Road Bridge.

Sir William Arrol and Co., Ltd., of Glasgow, have just erected a road bridge over the river Gryfe, in Renfrewshire. The outstanding feature of this bridge is that the flange plates, web plates and stiffeners of the main girders are all welded together by the electric arc process. The floor of the bridge is of concrete slab construction, carried on cross girders, supported by two main girders 67ft. in length. This is the first instance of the application of electric arc welding to road bridge building in Scotland, though the process has already been utilised in the construction of small-span railway bridges and the repair and strengthening of existing railway bridges.

Coal.

Business in the Scottish coal market continues on comparatively quiet lines. In neither the home nor export branch is there any pressure for supplies, and most descriptions are fairly plentiful at the moment. Limitation of foreign exchange facilities and heavier import duties abroad restrict export, apart from the fact that shippers find difficulty in securing business on the basis of present prices. Some prompt transactions have been concluded, but forward business is well-nigh impossible, not only because of prices, but also due to the operation of the quota system. Steam and navigation fuels are moving fairly freely, and Lanarkshire splints have a steady outlet, but washed materials have lost some of their recent strength. The smaller sizes especially show signs of weakness, due in a measure to the decline of foreign demands. Aggregate shipments amounted to 212,038 tons, against 160,850 tons in the preceding week, and 205,894 tons in the same week last year. Continued mild weather has reacted against the home market, collieries finding it impossible to impose the usual seasonal advances in price.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

ALTHOUGH the immediate position of collieries producing steam coals has been slightly better this week than last, it has to be admitted that the conditions prevailing as a whole have been very quiet, and at the moment the outlook is by no means satisfactory. There is this, however, to be said—though it affords no great consolation—that the situation so far as the coal industry on the Continent is concerned, is certainly no better than it is here. South Wales cannot derive any satisfaction, either, from the returns just issued by the Customs relating to the coal exports for the whole of this country for the month of December, which show that this district has lost ground, as the total came to only 1,386,281 tons, as compared with 1,418,002 tons for November. It has to be noted, moreover, that the returns for December were actually the lowest for any month of 1931, with the exception of January, during which month there was trouble in the coalfield over the hours question at the pits, and no work took place for the first fortnight. The returns of the Great Western Railway Company of shipments at the leading ports for last week compared, of course, favourably with the figures for the corresponding period of 1931, but, still, were not really satisfactory. The total was 375,925 tons, which was 62,345 tons better than the preceding week, and compared with 111,925 tons for the corresponding week of 1931. Last week finished up, however, with a total of forty-eight vacant loading berths at South Wales ports, and the situation in this respect on Monday was that the number of vacant berths was reduced to thirty-eight, while on Tuesday the position was even better, as the total was twenty-nine. The fact is that, although the chartering of tonnage has not materially expanded, tonnage which has been held up by the extremely bad weather has come along more freely, and collieries have a better outlet for their coals. The demand from abroad is, however, very featureless, especially for prompt loading. In the case of the surtax to apply to coals discharged at Italian ports as from the beginning of this year, it is satisfactory to know that this impost of 2½ lire does not operate in the case of coals for bunkering purposes. So far as France is concerned, there has been no fresh development, and business appears to be even more restricted in coals for shipment to that country. The report is current that, recently, the French State Railways contracted for about 200,000 tons of Welsh coals for delivery over the whole of this year, this not being, however, new business, but a renewal of contracts. New inquiries are very limited, the only one of any note being from the Norte Railway of Spain for prices for about 15,000 tons of coals for shipment during the next two months. The Palestine Railways are reported to have bought 12,000 to 14,000 tons of steam coals from a leading firm of Cardiff exporters for delivery at Haifa.

Coal for Oil.

The "back to coal" movement is still very much alive in this district, and at the end of last week there was a well-attended meeting at Cardiff under the presidency of the Lord Mayor, when the joint secretaries presented an appeal which they suggested should be placed before the Prime Minister as early as possible. After fully discussing this appeal, a sub-committee representative of the coalowners, the Chamber of Commerce, the Shipowners' Association and the Coal Exporters' Association, together with the joint secretaries, was appointed to prepare a final draft for submission to the Premier.

Steel and Tin-plate Items.

The announcement is made that an order for the redesigning and construction of a furnace for the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., at their works at Cardiff, has been secured by Ashmore, Benson, Pease and Co., Ltd., of the Parkfield Works, Stockton-on-Tees. The directors of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., have appointed the deputy managing director—Mr. James Spencer Hollings—to succeed the late Mr. William Simons. Mr. Hollings is a director of the Brymbo Steel Company, Ltd., the Briton Ferry Works, Ltd., the British Mannesmann Tube Company, Ltd., and other undertakings, and is also a member of the Council of the Federation of British Industries and the Iron and Steel Institute. In connection with the movement for reviving the regulation of the tin-plate trade, it is reported that the new proposal deals with the control of the output only, and that one of the principal conditions attached to the scheme is that the support of the whole of the tin-plate manufacturers in South Wales shall be forthcoming. It is proposed that a committee of three, representative of the whole industry, shall administer the scheme.

South Wales Electrical Development.

The official announcement was made at the end of last week that the South Wales Electrical Power Distribution Company has agreed to supply all the power requirements of the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., and of the Welsh Associated Collieries, Ltd., and to take over the large Dowlais power station owned by the two concerns named. The arrangements include the control of the large Dowlais power station of the Guest, Keen, Baldwins group being included in the organisation of the South Wales Power Company, while the high-pressure distribution system previously operated by the British (Guest, Keen, Baldwins) Company will be incorporated in the very extensive system of power distribution lines of the South Wales Power Company.

Current Business.

The steam coal market for early loading is quiet from the point of view of fresh inquiry. Here and there a few small cargoes are fixed up, but the volume of operations is generally small. Collieries though working this week a shade better than last, are by means well employed, and many of them are still losing time. Prices display no change, and for the most part are at the minima. Coke is steady, though not as active a market as was the case a few weeks ago. Patent fuel also shows no material expansion, while pitwood meets with comparatively little demand and remains about 23s. 6d. to 24s. 6d.

CATALOGUES.

BRITISH INSULATED CABLES, Ltd., Prescot.—Catalogues 261 and 264, on "Service and Straight Joint Boxes," and "Fuse Boxes and Switch Fuses."

WM. BEARDMORE AND CO., Ltd., Parkhead, Glasgow.—A book illustrating and describing the firm's high-speed heavy-oil engine for air, road, sea and rail use.

MCKECHNIE BROS., Ltd., Rotton Park-street, Birmingham.—A list of extruded rods and sections, stampings and pressings, chill cast bars and ingots in non-ferrous alloys.

PYRENE COMPANY, Ltd., Great West-road, Brentford, Middlesex.—Details of the "Parkerising" rust-proofing process and the "Bonderising" process for holding paint to steel.

PATENT GEAR AND METAL HARDENING COMPANY, Ltd., 69, Horseferry-road, S.W. 1.—A booklet providing some precise information on the "Shorter" process of surface hardening.

IGRANIC ELECTRIC COMPANY, Ltd., 149, Queen Victoria-street, E.C. 4.—Publication 6745, on "Inductive Limit Time Control," and leaflet 780 on "Battery Charging Equipment."

BARCLAY, CURLE AND CO., Ltd., North British Engine Works, Whiteinch, Glasgow.—A 63-page illustrated brochure of the firm's activities in shipbuilding, engineering, and ship repairing.

JAMES HOWDEN AND CO., Ltd., Caxton House, London, S.W. 1.—Particulars of the "Brachelsberg" furnace for the melting of cast iron, steel, alloy irons and non-ferrous metals.

SCREW GRIP.—We have received from the Screw Grip Company, of Romford, Essex, a specimen of a device for holding a screw in contact with a screwdriver to facilitate work in awkward places. The "grip" consists of a short length of helical spring which is threaded over the shank of the screwdriver, upon which the upper part takes a firm hold. The lower end is provided with a hook which engages the head of the screw and holds the slot firmly on the edge of the blade. Various sizes are made.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/– to 19/6
(1) Spanish	17/– to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6 to 17/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 4 6 to 3 5 0	
	3 4 6 to 3 5 0	
No. 1	3 5 0 to 3 5 6	
	3 5 0 to 3 5 6	
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.	10 5 0	9 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 15 0 to 8 0 0	—
Small Re-rolled Bars	6 17 6 to 7 0 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 0 0 to 9 2 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/3 to 14/9
Block Tin (cash)	140 15 0
„ (thre months)	143 16 0
Copper (cash)	39 5 0
„ (three months)	39 7 6
Spanish Lead (cash)	14 18 9
„ „ (three months)	14 18 9
Spelter (cash)	14 5 0
„ (three months)	14 12 6
MANCHESTER—	
Copper, Best Selected Ingots	43 10 0
„ Electrolytic	48 0 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 10
„ Condenser, lb.	0 1 0½
Lead, English	16 10 0
„ Foreign	15 2 6
Spelter	14 10 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 12 6	7/–
„ „ 6 p.c. to 8 p.c.	£23 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 15 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 10 0	10/–
„ „ „ 1 p.c. carbon	£43 10 0	12 –
„ „ „ 0·70 p.c. carbon	£52 10 0	13/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£9 15 0 scale 5/– per unit	
„ „ 75 p.c.	£15 10 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	10/– per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	14/3
„ „ Splint	14/3 to 16/–
„ „ Trebles	15/9
„ „ Doubles	13/–
„ „ Singles	10/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/–
„ „ Trebles	15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/9
Screened Navigation	17/–
Trebles	15/6 to 16/–
Doubles	13/–
Singles	10/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/3 to 12/9
Secondary Steam	12/3
Trebles	15/6
Doubles	13/–
Singles	10/–

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/8
Coke	20/– to 21/6
NORTHUMBERLAND—	
Best Steams	13/9 to 14/–
Second Steams	12/– to 12/6
Steam Smalls	8/6 to 9/–
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6 to 14/9
Second	13/6
Household	25/– to 37/–
Foundry Coke	24/–

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	26/– to 27/–	—
South Yorkshire Best	24/– to 25/–	—
Derbyshire Best Bright House	20/6 to 21/6	—
Best House Coal	22/– to 23/–	—
Screened House Coal	19/– to 20/6	—
Best Screened Nuts	17/– to 18/–	—
Small Screened Nuts	15/6 to 16/6	—
Yorkshire Hards	17/– to 18/6	—
Derbyshire Hards	17/– to 18/6	—
Rough Slacks	9/– to 10/–	—
Nutty Slacks	8/– to 9/–	—
Smalls	5/6 to 6/6	—

Blast-furnace Coke (Inland).. 12/– to 12/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 18/– to 19/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 27/–
No. 3 Rhondda Large	19/9 to 20/–
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	19/– to 19/3
Pitwood (ex ship)	23/– to 24/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 49/6
Beans	28/6 to 32/6
Peas	19/– to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals :	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate; Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from Associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Steel Import Restrictions.

THE constitution of the national Steel Pact has been followed by a decree limiting the imports of steel sheets to what is required to make up for any deficiency of the home production. Whether that is a mere coincidence, or whether import quotas are to become a necessary consequence of the national Steel Pact, it is difficult yet to say; but it appears fairly obvious that the new organisation amongst steel producers can hardly be effective unless the home industry is protected from unrestricted imports. Everything, therefore, points to a possible extension, eventually, of the quota system to other steel products. The imports of steel sheets have been increasing so rapidly of late that the Government has now restricted them and allotted maximum quantities to the different countries in proportion to what they have been sending into France. During the first three months of the present year, the total quantity of iron and steel sheets to be imported is not to exceed 900 metric tons a month for sheets of full size, and 250 metric tons for sheets that have been sheared to special dimensions. Of the full-size sheets, 800 metric tons are allocated to Belgium and Luxemburg, and 100 tons to other countries. The maximum quantity of sheared sheets to be imported monthly from Belgium and Luxemburg is 145 metric tons; from Great Britain 45 tons; from Germany 50 tons, and from other countries 10 tons. Meanwhile, negotiations continue in Paris for the reconstitution of the international Steel Cartel, with a central sales organisation; but the chances of reaching some satisfactory result are believed to be diminished by the new import quotas for steel sheets, as well as, possibly, of other steel products. All that can be said at the moment is that agreement has been reached on certain principles, but there are serious difficulties in the way of the Cartel, notably in fixing the quotas. So far as concerns the effect of the import restrictions upon the Cartel, it appears that they have been imposed with the idea of entering into agreements with other countries which will not be subjected to the import quotas if they offer corresponding advantages.

Coal.

The conference of Government representatives and coalowners and miners concluded at Geneva last week with the impression that something tangible had been done in the way of organising the international coal trade. The attitude of British coalowners was appreciated, because it was feared that, with the fall of the pound in foreign markets, they would make the most of their advantage during the negotiations; but the organisation of the coal trade cannot be affected by temporary influences, and the British delegates fell in with the general ideas of what should be done to work out the salvation of the colliery industry. The main lines of the organisation are that each producing country shall first take the fullest advantage of the home consumption and increase it as much as possible by improving the methods of distribution, each colliery district adopting the most efficient means to cover its special home market. When all the producing countries have completed their national organisations, the exports will be regulated according to the surpluses available in the different countries and the requirements and situation of markets. All this will be done with a view to maintaining prices and allowing miners to be paid suitable wages. Nothing has yet been settled as to how the scheme will be carried through. The scheme itself will be drafted by the existing Commission when it has all the data in hand, and there is a question of forming an international committee under the direction of the League of Nations to see to its execution, though the miners' claims to be represented on the committee, in sufficient force to influence its conduct, is not acceptable to coalowners. On the whole, while an attempt is being made to organise special markets, there will be a good deal of latitude in dealing with neutral markets, on condition that there is no cutting of prices, and it is seen that while the proposed organisation can do useful work in the interests of the colliery industry, it would probably fail if bound up with hard-and-fast rules.

National Fuels.

The problem of utilising home and colonial liquid and solid fuels with a view to rendering France as far as possible independent of foreign supplies, was thoroughly dealt with at the congress which was held throughout the second half of last year, and a final conference at the Société des Ingénieurs Civils last week summarised the practical results obtained by experiments and tests preparatory to sending a mission to Africa next month with the object of running motor cars on locally produced oils. As to the future of these new motor fuels there is a remarkable optimism, which is said to be justified by the results of tests, in which mixtures of vegetable oils and shale and lignite oils, usually with petrol, are said to have given quite satisfactory results, even in petrol engines. The tests do not appear to have been carried out over long enough periods to show what may be the ultimate effect of employing more or less acid fuels. Monsieur Metral, Professor at the Ecole Nationale Aeronautique, dealt with tests he had made with a solid-injection engine running on different home fuels, which showed very little variation in the indicator diagrams. He also described a new apparatus known as the "Forflex," for treating shale, lignite and oleaginous vegetable products by what is practically a low-temperature carbonisation process. Monsieur Charles Roux, who will be in charge of the African motor car caravan, suggested that it would probably be cheaper and more convenient to run the engines on ground nut oil from a filter press and the cake could be treated by the low-temperature carbonisation process. Monsieur Metral declared that gas oil is more variable in its composition than the vegetable product; but, after all, the question of cost is a serious barrier to the practical use of vegetable oils as an engine fuel, unless they can be employed in the raw state from the filter press.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

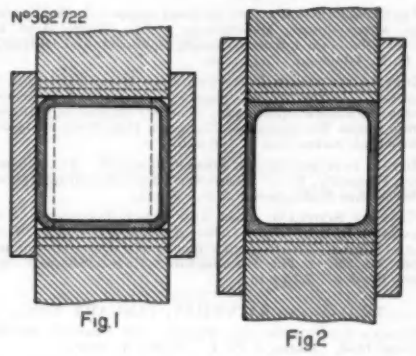
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

362,722. January 9th, 1931.—WATER-TUBE BOILER HEADERS, Vereinigte Stahlwerke Aktiengesellschaft, 67, Breitestrasse, Düsseldorf, Germany.

It is suggested in this specification that in the process of making sinuous headers of the type usually associated with the Babcock boiler there is danger of cracks developing at the corners of the

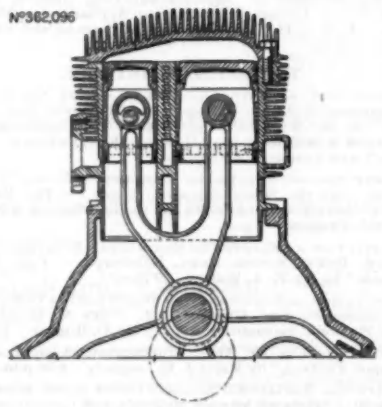


square tube as it is being pressed into the sinuous form, on account of the lack of support in the dies at the corners. Fig. 1 shows the usual style of tube and arrangement of dies. Fig. 2 shows the style of tube that fills the dies right up into the corners which the inventors advocate. The method of making such a tube is not disclosed.—*December 10th*, 1931.

INTERNAL COMBUSTION ENGINES.

362,096. October 18th, 1930.—TWO-STROKE TWIN-CYLINDER ENGINES, *F. B. Dehn*, 103, *Kingsway, London, W.C.* 2.

This engine is rather after the fashion of that of the Trojan motor car, but it has two peculiarities. The two pistons are of different diameters, giving an area to that on the inlet side of

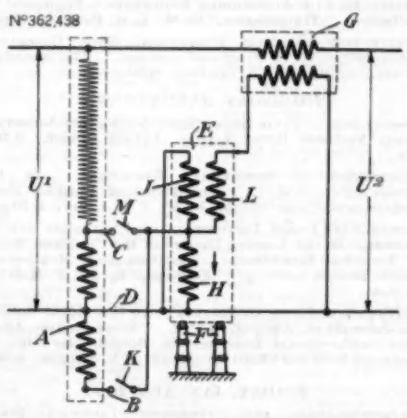


about two and a-half times that on the exhaust side, while exhaust is effected at a pressure of about 40 lb. per square inch. The smaller piston, it will be noticed, is fitted with a gudgeon pin embraced by an excentric, and this, it is claimed, adapts itself to the unequal angularity of the two branches of the connecting-rod as the main crank rotates.—*December 3rd*, 1931.

TRANSFORMERS AND CONVERTERS.

362,438. May 29th, 1930.—TAPPING DEVICE FOR STEP TRANSFORMERS, Koch and Sterzel Aktiengesellschaft, of Zwickauerstrasse 40/42, Dresden-A. 24, Germany.

In accordance with this invention an induction regulator

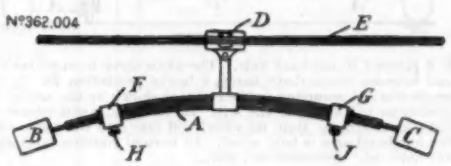


is used in conjunction with transformer tap-changing switches, and, in order to avoid the use of heavy insulation in the slots of the induction regulator, the latter is insulated from earth. A is the tapped winding of the auto-transformer, and B, C, D, are the tappings. E is a sliding core induction regulator having a divided energising winding, the regulator being mounted on insulators F. G is a supplementary transformer connected in the line. In the arrangement shown, the tappings B, C and D are so grouped that the tapping D is common to both portions of the winding A. Current passing from one line through the tapping D flows through the two portions H, J of the energising winding. If now the switch K at the tapping B is closed and assuming the windings of the regulator E to be in the position shown, the potential U_2 is equal to the input potential U_1. If, then, the secondary winding L is moved in the direction of the arrow to the central position, the potential U_2 will be increased to that at the tapping B. If the secondary winding L is moved to its lowermost position, the potential U_2 will again be increased by an amount equal to the first increase—that is, by twice the difference of potential between the tappings D, B. If, instead of closing the switch K, the switch M at the tapping C is closed, the output potential U_2 will be reduced to the same extent when the winding L is varied in the manner described.—*November 30th*, 1931.

TRANSMISSION OF POWER.

362,004. September 5th, 1930.—MEANS FOR DAMPING THE OSCILLATIONS OF OVERHEAD ELECTRIC LINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The damper shown consists of a bundle of plate springs A, which at each of its two ends is provided with a weight B and C, and is suspended at its centre by a clamp D from the line E. If vibrations take place in the line, then the masses B and C are caused to make free vibrations. The separate layers of the bundle of flat springs then rub against each other and produce

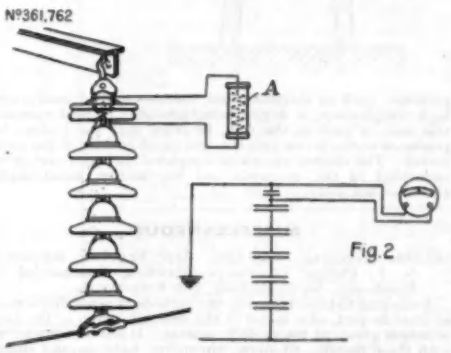


friction which converts a part of the oscillation energy into heat and thus dissipates it. The separate leaves of the bundle of springs are each surrounded by a clamping loop F and G. The loops are each provided with a set screw H and J, which permit the flat springs to be pressed more or less closely together. Preferably, the loops H and J are rigidly connected with the upper plate of the spring bundle, so that they cannot fall out. The other leaves must, however, be capable of displacement in the loop, as otherwise the spring action between the loop and the clamping point of the loop would have no effect.—*December 3rd*, 1931.

MEASURING AND TESTING INSTRUMENTS.

361,762. March 7th, 1931.—MEANS FOR OBTAINING CURRENT FROM A HIGH-TENSION TRANSMISSION LINE FOR OPERATING INSTRUMENTS, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.* 2.

Briefly stated, the method of obtaining current from H.T. overhead lines for operating instruments in accordance with this invention is to provide a string of insulators with one insulator

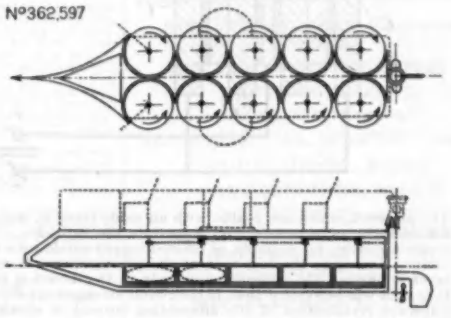


of less electrostatic capacity than the others, and to shunt the measuring apparatus across that insulator, as shown at A, Fig. 1. The arrangement A is a neon lamp, and apparently its object is to indicate to aviators their proximity to overhead lines. In Fig. 2, however, is shown an instrument connected across the low-capacity insulator, and the inventors explain that such instrument may be a phase or other meter, oscillograph, or the like.—*November 26th*, 1931.

SHIPS AND BOATS.

362,597. October 20th, 1930.—SHIPS' HULLS, C. Wedekind, 1, Piazza Grimaldi, Genoa, Italy.

The object of the invention is to provide an unsinkable ship's hull, the speed of which, for a given driving power, is higher than that of known ships' hulls, in consequence of the diminution



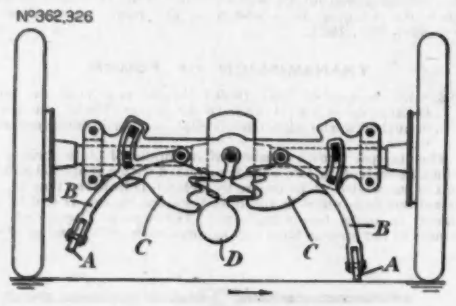
in the resistances to propulsion. The resistances that a ship's hull has to overcome consists in the displacement or wave-making resistance arising from the breadth of the ship and the frictional resistance between the ship's sides and the water. According to the invention, these resistances are reduced and

in part eliminated by substituting for the immersed part of the usual rigid ship's hull floats revolving about vertical axes, in such a way that the rigid portion of the ship's hull remaining above the water line and intended for the reception of the cargo is carried by the pivots of the floats and the speed of revolution of the latter is kept in harmony with the speed of travel of the ship.—*December 10th*, 1931.

MOTOR CARS AND ROAD VEHICLES.

362,326. May 18th, 1931.—A NON-SKID DEVICE, H. R. Kirk, 4, Exeter-road, Weston-super-Mare.

The inventor proposes to check the side-slipping of motor cars by providing a pair of small auxiliary steel wheels, which are automatically brought into contact with the road in the event of a slip developing. These wheels A A are carried by arms

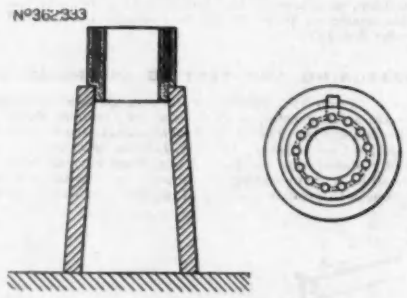


B B pivoted to the back axle. The arms carry horn-plates C C, and between them there hangs a heavy pendulum D. In the event of a slip occurring to the right, as shown by the arrow, the pendulum will swing to the left. In doing so, it will release the right-hand arm so that its wheel will bite into the road, while the left-hand arm is held clear. In normal running both arms are held up.—*December 3rd*, 1931.

METALLURGY.

362,333. July 13th, 1931.—MOULDS FOR CASTING METALS, E. Bornand, 112, Route de Florissant; and H. Arnold Schlaepfer, of 13, Rue Verdaine, Geneva, Switzerland.

This invention relates to moulds for casting metals. The mould has a part of its wall at least made of a refractory substance which is a bad conductor of electricity at normal tem-

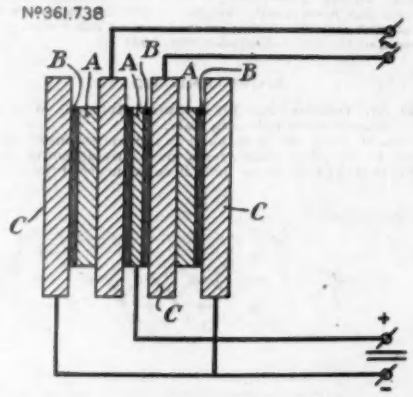


perature, such as magnesia, but becomes a good conductor at high temperature, a device being provided to feed current to this wall or part of the wall, in order that the joulean heat produced in the latter prevents too rapid cooling of the molten metal. The electric circuit is completed between carbon rods embedded in the magnesia and the molten metal itself.—*December 3rd*, 1931.

MISCELLANEOUS.

361,738. February 13th, 1931.—DRY ELECTRIC RECTIFIERS, N. V. Philips' Gloeilampenfabrieken, Emmasingel 13D, Eindhoven, North-Brabant, The Netherlands.

According to this invention, the cathode of a rectifier consists, at least in part, of a metal of the first sub-group of the fourth principal group of the periodic system. It has been found that with these metals—titanium, zirconium, hafnium, and thorium—a satisfactory rectifying effect can be obtained. The cathode consisting of one of these metals is preferably coated with a layer consisting of one or more compounds of the metal. Use is preferably made of a film consisting of one or more oxides of the metal constituting the cathode. It has been found that, owing to the extreme permanency of the oxides of these metals, the rectifiers thus produced have an almost unlimited life.



The plates A, which are coated with an oxide layer B, consist, for example, of zirconium and constitute the cathodes. The plates C consist, for example, of pressed copper iodide with free iodine. Owing to the fact that, at the points where an oxide layer is present, the current passes only in the direction from C to A, it will be evident that, in the circuit arrangement shown, full-wave rectification of the alternating current is obtained, and that during each half-cycle two elements are traversed in series. The above-described rectifiers may be utilised for all purposes for which rectifiers have been utilised up to the present. According to the manner in which the rectifier is to be utilised, it is possible to choose a suitable combination for the material of the electrodes to meet specific requirements.—*November 26th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

BRITISH INDUSTRIAL PURCHASING OFFICERS' ASSOCIATION.—At Hotel Rubens, Buckingham Palace-road, S.W. 1. "The Value of a Centralised Purchasing Department," by Mr. J. McDowell. 6 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Hotel Metropole, Leeds. "Progressive Methods Applied to a Modern Shop for Electric Rolling Stock," by Colonel E. Graham. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Ball Bearing Manufacture," by Mr. Wilfrid Fish. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—At the Engineers' Club, Albert-square, Manchester. "The Waste Heat Boiler and its Effects on Furnace Design, Operation and Output," by Mr. G. R. Adamson. 7.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre, Literary and Philosophical Society, Newcastle-upon-Tyne. Further discussion, "Improved Marine Steam Reciprocating Engines: Does their Performance Justify their Extra Cost?" 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "The Expanding Universe," by Sir Arthur Eddington, F.R.S. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—In the "Societies Room," No. 24, Royal Technical College, George-street, Glasgow. The Council will meet at 6.45 p.m. in Committee Room No. 26. "The Manufacture of Steel Sheets," by Mr. James Bryden. 7.15 p.m.

TO-DAY AND SATURDAY, JANUARY 23RD.

MODELS EXHIBITION AND PAGEANT OF POSTAGE STAMPS.—Dorland Hall, London, S.W. 1. 10.30 a.m. daily.

SATURDAY, JANUARY 23RD.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND STUDENTS' SECTION.—Visit to British Broadcasting Corporation, Moorside Edge Station, near Huddersfield. Meet 2 p.m. at General Post Office, City-square, Leeds.

MONDAY, JANUARY 25TH.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN CENTRE.—At Armstrong College, Newcastle-upon-Tyne. "Methods and Equipment in Cable Telegraphy," by Messrs. H. Kingsbury and R. A. Goodman. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, St. James's Park, S.W. 1. "Locomotive Testing and Research," by Mr. J. E. Bell. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture II.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 26TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Discussions: "Calcutta Port Extensions," by Mr. Wilfrid Cracroft Ash; "The Construction and Sinking of Monoliths at King George's Dock, Calcutta," by Mr. James Davis Pearson. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—At the Hotel Metropole, Leeds. "The Electrical High-pressure Testing of Cables and the Localisation of Faults," by Mr. J. Urmston. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "Coal Ignition Systems," by Mr. E. A. Watson. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND. 39, Elmbank-crescent, Glasgow, C. 2. "The Air Resistance of Ships' Hulls and Superstructures," by Mr. G. Hughes. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Empire Timbers," by Major J. R. Cosgrave. 4.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—195, West-street, Sheffield. "Tests of Aircraft Materials and Components," by Mr. J. G. Gerrard. 7.30 p.m.

WEDNESDAY, JANUARY 27TH.

BRITISH WOOD PRESERVING ASSOCIATION.—In the Lecture Hall, Auctioneers' and Estate Agents' Institute, 29, Lincoln's Inn-fields, London, W.C. 2. "Diseases of Timber," by Mr. K. St. G. Cartwright. 6 p.m.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Caxton-street, S.W. 1. Consideration of the Report of the Committee on Heavy Oil Engine Working Costs (1930–31). 3.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Transmission," by Mr. L. H. Pomeroy. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' meeting. "The Manufacture of Gears," by Mr. A. C. Z. Browne. 6.30 p.m.

THURSDAY, JANUARY 28TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Great Northern Hotel, Leeds. Annual Dinner. 6.30 for 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS. 10, Upper Belgrave-street, S.W. 1. "The Effect of Existing Building Regulations on Pillar Design," by Mr. F. E. Drury. 6.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Teesside Branch meeting. "Forgings," by Mr. J. MacGregor. 7.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Some Factors Affecting Range, with Special Reference to Height," by Mr. A. E. Woodward-Nutt and Flight-Lieutenant A. F. Scroggs. 6.30 p.m.

FRIDAY, JANUARY 29TH.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—At the Comedy Restaurant, Panton-street, Haymarket, W. 1. Annual Dinner and Dance. 7.30 p.m. for 8 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, S.W. 1. "The Mechanism of Electric Locomotives," by Mr. J. D. Twinberrow. 6 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—84, Eccleston-square, S.W. 1. Metropolitan District meeting. 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Centrifugal Separation of Liquids—Industrial Applications to Oils and other Fluids," by Mr. J. J. Haslam. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—"Modern Dutch Yard Arrangement and Practice," by Mr. A. Van Donkelaar. 6 p.m.

MONDAY, FEBRUARY 1ST.

INSTITUTE OF FUEL.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Presentation of Melchett Medal and Melchett Lecture, "A Century of Fuel Economy," by Professor W. A. Bone, F.R.S. 6.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Life Saving Appliances on Merchant Ships" (Lecture III.), by Captain A. O. Barrand and Mr. G. A. Green. 8 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—The Victoria Hotel, Wolverhampton. "Waste Heat Boilers," by Mr. F. Jones. 7.30 p.m.

TUESDAY, FEBRUARY 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Epicyclic Gearing," by Major W. G. Wilson. 7.45 p.m.

WEDNESDAY, FEBRUARY 3RD.

MANCHESTER METALLURGICAL SOCIETY.—In the Engineers' Club, Albert-square, Manchester. "Metals for Use at High Temperatures," by Mr. J. H. G. Monypenny. 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Geophysical Methods of Prospecting," by Mr. A. Broughton Edge. 8 p.m.

THURSDAY, FEBRUARY 4TH.

INSTITUTE OF FUEL.—Joint meeting with the Society of Chemical Industry, in the Chemical Department of the University, Bristol. "Smoke Abatement," by Mr. V. R. Chadwick. 7.30 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "The Dilatometer in the Study of Steels," by Mr. N. P. Allen. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—At the Connaught Rooms, Great Queen-street, W.C. 2. Annual dinner and reunion. 7 p.m. for 7.30 p.m.

FRIDAY, FEBRUARY 5TH.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—Hotel Russell, Russell-square, W.C. 1. Supper dance. 8 p.m. to 2 a.m. Tickets may be obtained from Hon. Secretary, Faraday House O.S.A., Southampton-row, W.C. 1.

INSTITUTE OF FUEL.—In the Lecture Theatre, Derby Technical College, Green-lane, Derby. "Industrial Furnace Design," by Mr. E. W. Plumley. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Informal Meeting. Discussion on "Pile-driving Plant," to be opened by Mr. C. H. Woodfield. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Notes on Hydraulic Installations in New Zealand," by Mr. H. S. Lamburd. 7.30 p.m.

SATURDAY, FEBRUARY 6TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH—Grand Hotel, Manchester. Annual dinner. 6.30 p.m.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Dudley Arms Hotel, Dudley. Annual Dinner. 6 for 6.30 p.m.

MONDAY, FEBRUARY 8TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Aluminium-silicon Alloys: Their Properties and Some Applications," by Mr. R. B. Deeley. 7.30 p.m.

TUESDAY, FEBRUARY 9TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Joint meeting with the Newcastle Branch, Institute of British Foundrymen, in the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Some Developments in Non-ferrous Alloy Founding," by Mr. H. C. Dews. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—At the Y.M.C.A., Swansea. "Zinc—the Utility Metal," by Mr. E. Evans. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "Epicyclic Gearing," by Major W. G. Wilson. 7.30 p.m.

WEDNESDAY, FEBRUARY 10TH.

INSTITUTE OF FUEL.—Joint meeting with the Sheffield Chamber of Commerce, at the Cutlers' Hall, Sheffield. "The Utilisation of Coke Oven Gas in the Iron and Steel Industry," by Dr.-Ing. H. Lent, of the Vereingte Stahlwerke A.G. 6.15 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Joint meeting with the Electroplaters and Depositors' Technical Society, at the Northampton Polytechnic Institute, St. John's-street. "Some Recent Advances in Protective Coatings on Metals," by Mr. H. Sutton. 8.15 p.m.

FRIDAY, FEBRUARY 12TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Spectrographic Methods of Chemical Analysis," by Dr. H. W. Brownsdon and Mr. E. H. S. van Someren. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Epicyclic Transmissions," by Major W. G. Wilson. 7.30 p.m.

MONDAY, FEBRUARY 15TH.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—The Victoria Hotel, Wolverhampton. "Beet Sugar Manufacture," by Dipl. Ing. Karl Hampel. 7.30 p.m.

WEDNESDAY, FEBRUARY 17TH.

INSTITUTE OF FUEL.—(This meeting has been postponed from February 10th.) Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. "The Properties of Coals as Controlled by their Composition," by Professor George Hickling. 6 p.m.

FRIDAY, FEBRUARY 19TH.

INSTITUTE OF FUEL.—At the Engineers' Club, 17, Albert-square, Manchester. "The Maintenance of Uniformity in Industrial Fuels," by Dr. A. C. Dunningham. 7 p.m.

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